Jacob Bronowski,
The Compassionate Scientist

Peter Sarfaty, BA (Sydney), BA (Hons) (Murdoch),
Dip Clin Psych (UWA)

This thesis is presented for the degree of Doctor of
Philosophy, Murdoch University

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Declaration

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary educational institution.

________________________________________

Peter Sarfaty
Dedication

To Elizabeth Joan Sarfaty
Abstract

This thesis attempts to analyse the life of Bronowski through his work and his discussions of his personal values, so the reader will gain an understanding of the “creative imagination” in science and art, as basic to human specificity.

Jacob Bronowski was born in Lodz, Poland, in 1908, the eldest of three sons of Abram Bronowski and Celia Flatto. During WWI, Russia invaded Poland, the family moved to Germany, and in 1920, Abram who had a linen export business with England moved the family to England. Jacob, who spoke no English, went to the Central Foundation School in London, and on to Cambridge University, where he was a student of Jesus College, graduating with a PhD in Mathematics in 1933.

Being in England gave Bronowski a “light” experience after the “dark” of Poland. England’s “civilized minds” excited him and he was fascinated with the English language, which he described as “boney”, meaning the language, and the words, could be understood by topological (geometrical) structure. While at Cambridge, in companionship with another mathematician, William Empson, they edited a literary journal Experiment. This gives a lead to the “creative mind” which characterises the human species, a feature which Bronowski develops during the course of this thesis.

During a daylight air raid on London in 1941, Bronowski married Rita Colin (Coblitz) sculptor, and they subsequently had four daughters, Lisa, Judith, Beth and Clare.

In English schools, it was usual practice for boys to refer to each other by their surnames, and Bronowski, as a school boy and throughout the remainder of his life was known as Bruno, the Polish diminutive of Bronowski.

When he was at Cambridge, Rita realised, that as a Jew, her husband was not going to be accepted as a Fellow of Jesus College, so he left Cambridge and over the years 1945-1964, when he worked for the Government in England, he developed a reputation as a lecturer, broadcaster, public educator, literary critic, mathematician and extensive writer.

In the thesis, Bronowski’s works are analysed including: Science and Human Values, The Poet’s Defence, William Blake and the Age of Revolution, The Origins of Knowledge and Imagination, and the BBC TV production, The Ascent of Man, a
Knowledge and Imagination, and the BBC TV production, The Ascent of Man, a thirteen part series about the development of animal and human life, from the grunion, a fish on the beaches of La Jolla, San Diego up through modern day studies in quantum physics and DNA structures.

There is a seventh chapter which analyses, The Visionary Eye, a series of essays and lectures put together by his wife Rita in 1978 to show “the bright ribbon of imagination” in her late husband.

I created the thesis title Jacob Bronowski, the Compassionate Scientist to reflect how his values, and activities and ethics reach out to me and touch me. Bronowski’s belief that “being a Jew meant to me having a profound sense of intellectual values. It meant being tolerant of the thoughts of other minds, not out of indifference, but of respect, above all out of self respect ….. ethical values of Judaism state we are all responsible for each other.” (Bronowski, 1968: On Being a Jew).

These values led Bronowski out of the shock of seeing the destruction of Nagasaki from the atomic bomb, through his thoughts on the Spanish civil war, and the propaganda of Nazism, out of the “ashes” of Auschwitz (part 11 of The Ascent of Man) to become involved in human biology, meeting with Jonas Salk and joining the Salk Institute in 1964.

Writing the thesis has given meaning to my life, about optimism, courage and ethical values, and I do trust it will convey those values to the readers.
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I wish to thank my thesis supervisor, Professor Philip Jennings, Professor of Physics and Energy Studies for his personal interest, over many years, in the work I have done to produce this thesis. The thesis title which I used to begin with was The Passions, Beliefs and Values of Jacob Bronowski and when I felt the passion and changed the title to Jacob Bronowski, the Compassionate Scientist I felt that I have not only acknowledged Jacob Bronowski but my regard and respect for Professor Jennings also.

My late wife Elizabeth Joan Sarfaty, whom I mention in the Epilogue, not only consistently encouraged me, but also learned to use the word processor loaned by Murdoch University to type up the first five chapters, before her fatal illness overtook her in 2002. My dear wife is still with me, especially when I think of Jacob Bronowski (in chapter 6 of the thesis visiting Auschwitz) and crying out “we must reach out and touch people.”

This leads me to say that whenever I have wanted administrative reassurance about re-enrolment each year I value the responsiveness of Karen Olkowski and Anne Randell.

The thesis would not have moved much beyond chapter 5, had the Department Secretary June Burnett not taken up typing, checking, drafting chapters 6, 7 and 8. And I must mention the secretary of the Department in earlier days, Lyn Simpson.

The Murdoch University Library staff have never failed me in their responsiveness to my requests for books and articles. The names of Ari, Doris MacIntyre and Kay Weaver of the Extension Service come to me, Sue Dowling, Electronic Services Librarian and Jenny Smith, Science Department Librarian have been supportive. No doubt there are other members of the Library staff, whose names I do not know who have secured books from other Universities and interstate for me.

Murdoch University is a fine institution, going back to my early BA studies and I have photographs of shaking hands with Sir Ronald Wilson, Chancellor when I graduated in 1994, BA Hons as well as a photograph of my wife Elizabeth and I in the Perth Concert Hall on that occasion.
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Prologue

During the early stages of writing about Jacob Bronowski (Bruno, the diminutive of Bronowski, to all who knew him), it was apparent that his 66 years of life was governed by the belief that as a Jew he was responsible to give of his best to all people. As I read in the 1939, and later in the 1966 edition of his study of The Poet’s Defence, I discovered that Bronowski was a man with ethical values (eg he identifies with the Elizabethan gallant, Sir Philip Sidney among the eight ‘admired’ poets, he selected for study) and I titled the thesis, in the beginning The Values, Beliefs and Passions of Jacob Bronowski. As I went on to develop Chapter 1 The Panorama of Bruno’s Intellectual Struggle, followed by Chapter 2 As Reasoned as Geometry, followed by Chapter 3, William Blake and the Age of Revolution, I began to understand the compassion of Bronowski. As a boy of twelve years, the eldest of three sons, he moved with his parents, from the ‘dark ghettos’ of Poland, via Germany across the English Channel, with no knowledge of the English language. Later he came to understand, what he termed “the civilized mind” of people in England.

He learnt the English language attending the Central Foundation School in London and in 1933, graduated with a PhD in Mathematics from Cambridge University. His work in Physics, his distress at the Spanish civil war, the rise of Nazism, the destruction of Jews at Auschwitz and his concern and distress at the atomic bombing presented Bronowski as a man of deep concern and compassion. So I changed the title of the thesis to Jacob Bronowski, the Compassionate Scientist.

Thus, I wrote Chapter 4, a study of Bronowski’s work The Identity of Man in which he develops his epistemology, his concepts of the specific features of knowledge of man and woman. Bronowski said, “Knowledge is a creative endeavour by which we constantly keep the world afresh and seek more suitable analogies using the true facets of imagination. And imagination is tied to the will to knowledge, to the belief that by knowledge we are fulfilling our place in the world.” This idea comes forward again in The Ascent of Man (Chapter 6).

George Derfer, Visiting Fellow at the Salk Institute, in an interview with Bronowski when he was also at the Salk Institute to study ‘human specificity’, says to
Bronowski: "In your life I have never seen you separate poetry from science as most people seem to." (1974) Bronowski responds, "Poetry is a useful topic to bear in mind when talking about scientific items because it reminds you that you can communicate truth in a way which carries intellectual convictions without setting up equations about it."

Looking specifically at the contents of the book, The Identity of Man discussed in Chapter 4, there are four sections made up of four lectures Bronowski gave to the American Institute of Natural History:

(i)  A Machine or Self
(ii)  The Machinery of Nature
(iii) Knowledge of Self
(iv)  The Mind in Action

Hence the evolution of Bronowski’s epistemology covers the qualities of Truth, Honour, Dignity and Dissent.

Chapter 5 continues the study of Bronowski’s epistemology, and associates it with social behaviour. The title is The Origins of Knowledge and Imagination, and it deals with the reality of material and human affairs (science and the humanities).

Chapter 5 begins with the powerful volume, The Face of Violence, a BBC radio play. Here the violence is the evil violence of Nazism (Bosscamp) in the area of crude brutality. The play was broadcast by the BBC in 1950 and with Rene Clair, a French playwright, won the Prix Italia in 1951. The play in a published volume is preceded by six essays about the sins of authority in violence, eg studies of Mussolini and Hitler. But the story of the play is performed through two characters of Evil or destruction of Truth or Honour. It reaches a profound climax with the conclusion from Clarissa, a woman of deep sensitivity, who says “....we’ve learnt that nothing remains to be discovered except compassion....”

Chapter 5 develops the study of ‘human specificity’ (Bronowski’s phrase) through the Silliman lectures at Yale University. The titles are;

1. The Mind as an Instrument of Understanding
2. The Evolution and Power of Symbolic Language
3. Knowledge as Algorithms and Metaphors

5. *Error, Progress and the Concept of Time*


Chapter 6 covers *The Ascent of Man*, a 1973 BBC series containing thirteen episodes on growth from the grunion fish on the beach at La Jolla, San Diego, California, to the stone cutters in simple human life up to quantum physics via Isaac Newton and Ernest Rutherford. It also aroused the interest of academics in Britain at a time when TV was not regarded as suitable for science communication and was sneered at by some academics. Bronowski was nevertheless excited at the prospect of being a public educator in a newly developed medium. Each of the thirteen episodes has a title with a description of the contents in brackets. For example, Episode 5, *The Music of the Spheres* (Mathematics) deals with Pythagoras.

Bronowski spent over a year touring the world with his TV producers, crew and support staff. He travelled to Samos, an island in the Aegean Sea, a mile off the coast of Asia, to the Nazi prison camp at Auschwitz, for Episode 11 (*Knowledge or Certainty*), Bronowski, deeply affected by the ashes of victims of the crematoria, said, “we have to reach out and touch people” as he argued for Knowledge over the rigidity of Certainty.

In 1974, Bronowski, in poor health during the worldwide travelling, had completed the series and was in New Haven, US when he suffered a sudden heart attack and died, aged 66 years.

I wanted to respond to Bronowski’s plea to reach out to people, so I included Chapter 7 *The Visionary Eye*. This reviews a collection of essays and lectures assembled by his wife Rita with Piero Arioti, to illustrate “the bright ribbon of his (Bruno’s) imagination.”

Many of the lectures and papers that Rita selected are characteristically Bruno’s, eg *The Imaginative Mind in Art, The Imaginative Mind in Science* and poetry by Dylan Thomas, the Welsh poet and playwright. The two items of distinctive interest are firstly a lecture delivered to the Royal Institute of British Architects in 1955, *Architecture as a Science and Architecture as an Art*, the second item is titled *Art as a Mode of Knowledge*. 
Considering Architecture, Bronowski (1955) says “...the buildings of the great designers arch out of their materials as spontaneously as a fountain.” Bronowski (1955) considers the revolutions in architecture. “Gothic in France begins at once with the rib-vaults and the buttress and for three hundred years is a constant play on the freedom and limitations which those engineering devices give.” A second development in architecture “…A horizontal building... search for organized structure runs through the Renaissance. It floods in Baroque and exhausts itself there, because it had reached the limits of what the seventeenth century could sustain.” Then there is the work of Christopher Wren and Robert Hooke in the rebuilding of London after the great fire of 1666. “Architecture is not a jigsaw of technical tricks. A building is the coherent solution of a problem of living......” This is a very basic account of Bronowski’s views on architecture.

*Art as a Mode of Knowledge* is a series of lectures, first given by Bronowski to the 1952 AW Mellon series. Bronowski delivered the lectures on Art in the following order:

1. *The Power of Artifacts*
2. *The Speaking Eye. The Visionary Ear*
3. *Music, Metaphors and Meaning*
4. *The Act of Recognition*
5. *Imagination as Plan and as Experiment*
6. *The Play of Values’ in the Work of Art*

To conclude the lectures, Bronowski (1955) says “ you must always feel you are exploring the values by which you live and forming them with every single step you take. On that I think, beautiful is founded. That I think is what the work of art says.”

The Epilogue reviews how I came to watch *The Ascent of Man* on the TV with my wife Elizabeth in the 1970’s and how they led me to develop this PhD study of Jacob Bronowski. I came to regard Jacob Bronowski as a man of compassion, when in episode 11 of the *The Ascent of Man*, I saw him stand in a pool of ashes at the Auschwitz prison camp, the ashes being those of his cremated relations, and he reached out and cried “we must reach out and touch people.”
When my dear wife Elizabeth passed away from terminal cancer in 2002, and not long after my seventeen year old cat had to be euthanized due to blindness and other illnesses, I realized as Clarissa, the wife of a man who was a former enemy prison guard, said “....and we’ve learnt that nothing remains to be discovered except compassion.” This is so true and Jacob Bronowski, the Compassionate Scientist reached out and touched me ever since.

Peter Sarfaty

September 2006
Chapter 1: A Panorama of Bruno's Lifelong Intellectual Struggle

1.1 Bronowski the Broadcaster.

Pythagoras and my responses.

Many years ago, in fact in the 1970's, I watched Jacob Bronowski of the TV series *The Ascent of Man* (BBC 1973) describe in the episode *The Music of the Spheres* how the abstract concept of Theorem 29 was developed by Pythagoras. My mind recalled the lines from the poem *Little Gidding* by TS Eliot:

> We shall not cease from exploration  
> And the end of all our exploring  
> Will be to arrive where we started  
> And know the place for the first time

(Eliot, 1944 p43).

*Figure 1.1 Jacob Bronowski in a Characteristically Thoughtful Pose.*
Bronowski's account of the Greek philosopher Pythagoras born in 580 BC was a revelation, and an excitement to me. I went back in contrast to 1938, when as a fifteen year old schoolboy at Randwick Intermediate High School, in Sydney, I listened anxiously to the Maths teacher, who held his cane at the ready, use Hall and Stevens *A School Geometry* to give an account of Theorem 29 (Euclid 1.47). There were some thirty or forty boys in the classroom, and the atmosphere was dull and silent, as the teacher recited the theorem from pages 118 and 119 of the textbook, followed by the experimental proofs of the theorem on page 120. My mind roamed over the questions I wanted to ask but was afraid to ask: Who or what was Pythagoras? A person? A Greek god? A mountain? And why 29? And why was it deemed to be so important that "In a right-angled triangle the square described on the hypotenuse is equal to the sum of the squares described on the other two sides?" And why Hall MA? And why Stevens MA? Who were these people? And why was the book *A School Geometry* so cheerless?

Figure 1.2 Here Pythagoras Whimsically and Carefully Balances His Square on the Hippopotamus.
My experience in 1938 was not unique! When I ask my contemporaries, and people younger than myself about geometry, and especially about Theorem 29, there are usually groans.

One man responded with a smile: "The square described on the side of a hippopotamus is equal to the squares on the other two hides". I have discovered that my friend's smile has a long historical precedent, as this illustration from Grant and Pottinger (1965, p32) shows.

I am not being frivolous or derogatory towards the maths teacher of that era, or perhaps even now, but it was years before it occurred to me that the word "geometry" did not have to be frightening, it simply meant "earth measurement".

When I think back now, the text book used and the atmosphere of the school as a plain, undecorated brick structure, typical of its time, reflected the process of education as hand-me-down versions of what presumably English-Edinburgh academics had passed on to the Australian colony. The pages of Hall and Stevens are uninspiring. Theorem 29, as Bronowski explains, was important in elevating empirical knowledge to the level of abstract thought. Hall and Stevens fall short of the historical significance of the achievement of Pythagoras in the history of Greek mathematics, and its influence throughout the Arab world. Hall and Stevens did not do justice to Pythagoras or to the young school students.
THEOREM 29. [Codil I. 47.]

In a right-angled triangle the square described on the hypotenuse is equal to the sum of the squares described on the other two sides.

Let ABC be a right-angled \( \triangle \), having the angle ACB a rt. \( \angle \).

It is required to prove that the square on the hypotenuse AB is the sum of the squares on AC, BC.

On AB describe the sq. ADER; and on AC, CB describe the sqq. AOGF, CBKH.

Through O draw OL, perp. to AD or BE.

Join OD, OB.

Proof. Because each of the \( \angle \) ACB, ACG is a rt. \( \angle \).

\( . \), AD and CB are in the same st. line.

Now the rt. \( \angle BAD = \angle BAD \).

\( = \angle \) CAB, the whole \( \angle OAD = \angle FAB \).

Then in the \( \triangle OAD = \triangle FAB \).

because

\[
\begin{align*}
OA &= FA \\
AD &= AB, \\
\text{and the included } \angle OAD &= \angle FAB; \\
\therefore \angle OAD &= \angle FAB.
\end{align*}
\]

Theor. 4.

Theorem 29 Page 119

THEOREM 29 Page 120
By contrast the illustration showing theorem 29 in John Bonnycastle's book, etched by William Blake in 1782, arouses a sense of enquiry into the subject. William Blake himself was a fascinating man, and will be the subject of chapter 3.

AN INTRODUCTION TO MENSURATION, AND PRACTICAL GEOMETRY.

WITH NOTES, CONTAINING THE REASON OF EVERY RULE, CONCISELY AND CLEARLY DEMONSTRATIVE.

By JOHN BONNYCASTLE,

Author of the Scholar's Guide to Arithmetic.

LONDON: Printed for J. JOHNSON, No. 72,
ST. PAUL'S CHURCH YARD. 1782.

Figure 1.4 Cover of John Bonnycastle's book, etched by William Blake in 1782

As a further comparison with Hall and Stevens, I have included an illustration of Isaac Newton, a profound thinker in the history of science. This picture helps to make his influential law of inverse squares relating to the planetary movements more significant. It was generated by a recognizable human being.
This picture illustrates a chapter titled *Newton's Laws and His System of the World*, from a text book only forty years later than Hall and Stevens, namely, *Introduction to Concepts and Theories in Physical Sciences*, by Gerald Holton and Stephen Brush.

I have been concerned here, to contrast not only Bonnycastle's title page, and an illustration from Holton and Brush, with Hall and Stevens, but to show that science and art are generated by the common creative imagination in humans. This is one of Bronowski's key beliefs.

But to return to my experiences as a schoolboy. Not all of my schooling was tedious. I enjoyed the lessons in the languages, and I found meaning in reciting
the declensions in Latin, such as "amo, amas, amat, amamus, amatis, amant". I could relate these words to words in the English language: "amo", "I love". Young as I was, the word "love" had meaning to me in my daily life. This is the essence of my critical comments of text books and educational practices in those earlier years which were concerned only with presenting information "outside the student", and therefore of little relevance. I should add that the humanistic psychologist Abraham Maslow devotes an intense chapter titled Education in his book The Farther Reaches of Human Nature (1971, pp149-188), to presenting his view that extrinsic education is meaningless. Texts like Holton and Brush, and before them Bonnymcastle, must have been aware of this. Holton and Brush's text speaks personally to the reader.

I began to think more of Jacob Bronowski when during my Honours dissertation in 1993 I studied Niels Bohr as a Maslovian self-actualizing person. Abraham Maslow characterized the self-actualizing person, as one who moved beyond the commonplace experiences of daily life. Such a person experiences spontaneity of action, respect for others, concern for problem centering, and is able to distinguish means from ends. The quality of behaviour in being able to interrelate with other people is of major significance.

These features are seen especially in Jacob Bronowski and will be discussed at length as this chapter progresses. But for the moment I would like to refer again to the BBC television series The Ascent of Man, especially episode five: The Music of the Spheres.

I became enthralled when Bronowski described the Greek island of Samos, and the history of Pythagoras. To watch Bronowski explain the achievement of Pythagoras in geometry became a personal revelation to me. He was not only a geometrician. He was born about 580 BC on what Bronowski described as the "magical island of Samos", a mile from the Asian mainland. By about 530 BC Pythagoras was thinking of geometry. Over time his thinking expanded to develop the belief that Nature, which included the mathematical order in which the vibration of strings produced music, is commanded by whole numbers. Numbers are the language of Nature.
As the poet William Butler Yeats described him:

\[
\text{World-famous, golden-thighed Pythagoras,}
\text{Fingered upon a fiddle-stick or strings}
\]

from his poem *Among Schoolchildren*. (Yeats 1996, p47).

To return to Theorem 29. The right angle had been known to civilizations as far back as the Babylonians and the Egyptians. By holding one hand flat along the horizon line and the other against it like the gravity plumb line, a right angle is formed at the junction of the two hands. Then by joining these two lines with a third line, a right angled triangle is created and any particular right angled triangle independent of the length of the lines could be characterized beyond the specific three: four: five relationship.

![Figure 1.6 A Right Angled Triangle.](image)

So Pythagoras expanded from the operational case of the empirical three: four: five ratio of a right angled triangle into an **abstract** concept, a thinking awareness of Nature. Any right angled triangle could be characterized by the abstract idea of \( c^2 = a^2 + b^2 \). Hence the enunciation of the broad abstract principle; the square on the hypotenuse of the right angle triangle equals the sum of the squares on the other two sides.

Pythagoras's conceptualization of Nature commanded by numbers extended beyond music and beyond geometry to the movements of the planets and his influence was wide amongst his followers. The mathematical thinking associated with Nature commanded by numbers and particularly the abstract concept \( c^2 = a^2 + b^2 \) was subsequently accepted in the Arab world. It was the Arabs who were first so profoundly influenced by the patterns and numbers of Pythagoras' thought, because Asia Minor was only one mile across the sea from Samos, so Pythagorean knowledge could readily cross that mile into Asia.

Bronowski's use of the word "magical" about Samos, recalled for me a cruise around the Aegean Sea in 1978, when my wife and I spent a day on the island of
Delos. Delos was a small island with remnants of stone carvings of lions, columns from temples, mosaic paving stones and the like. In all seriousness, the guide said we must leave the island before nightfall because Apollo did not approve of humans on the island after dark. There was a sense of magic in the guide's words.

![Image of Delos site](image)

*Figure 1.7 Floor Tiling and Temple Columns on the Island of Delos.*

Stewart Richards put the Greek achievements in mathematics in broader perspective when he said: "On the invention of logic, usually attributed to the Greeks by their great interest in mathematics, particularly geometry, geometry itself drew upon knowledge of areas in accurate measurements, and the computation of areas. The Greek contribution was to transform the somewhat static ideas about the relations that held between lines and angles into a compelling system, which derived irrefutable conclusions from a number of different initial definitions and axioms". (Richards, 1983, p14.)

Richards' words create a sense of force that Bronowski showed in his presentation of Pythagoras which he titled *The Music of the Spheres*, both in the TV series and in the publication of *The Ascent of Man*. (Bronowski, 1973).
On page 159 of the book, concerning the right angled triangles rotating through the four points of the compass: North, East, South, West, he demonstrated the proof of Theorem 29, and with this the abstract concept derived from the proof that Nature is commanded by numbers. Page 159 of *The Ascent of Man* is reproduced. It contrasts vividly with the Hall and Stevens' version of the theorem.

*Figure 1.8 Bronowski's caption to Page 159 reads: "Pythagoras Raised this Knowledge out of the World of Empirical Fact Into the World of What We Should Now Call Proof".*

Bronowski's liveliness and the richness of his voice and words remained in my memory when I watched *The Music of the Spheres*. I was intrigued to find a reference to him as a "scientist-philosopher ... politically a socialist" in Richards. (1983, p138). I was more curious about Bronowski when I encountered a reference to him in *The Farther Reaches of Human Nature*, a work comprising a collection of papers, essays, and chapters for a proposed new volume of Abraham Maslow's studies on human nature as a naturalistic science, published posthumously in 1971 by his widow Bertha Maslow.

It is useful to quote the reference to Bronowski from Maslow's (1971) essay "Towards a Humanistic Biology". It points to one of the many directions that Bronowski's interests took, and this thesis will examine poetry, ethics, the place of humans in scientific activity among other subjects. Maslow says "... my feeling that the classical philosophy of science as morally neutral, value free is not only
wrong but is extremely dangerous as well. It is not only amoral, it may be antmoral as well. It may put us into great jeopardy. Therefore I would stress again, that science itself comes out of human beings and human passions and interests, as Polanyi (1958) has so brilliantly set forth. Science itself must be a code of ethics as Bronowski (1959) has so convincingly shown, since if one grants the intrinsic worth of truth, then all sorts of consequences are generated by placing ourselves in the service of this one intrinsic value." (Maslow, 1971 p20).

I have often wondered whether Maslow the psychologist and Bronowski the scientist ever met, or knew each other, because their thinking is so alike: Maslow on human behaviour as a natural science, and Bronowski’s belief in science as a human activity. Maslow, by linking Bronowski with science and a code of ethics has touched one of the lifelong passions of Bronowski. It was this reference to Bronowski that aroused me to write this thesis with the title *Jacob Bronowski, the Compassionate Scientist*.

### 1.2 The Nature of Bronowski.

*Himself, his family of origin, his Judaism*

To provide a biographical study of Bronowski (pronounced BRON-OFF-SKI) I have called on a wide variety of biographical sources. These include a memorial essay by his widow Rita; essays and dictionary references by his lifelong friend Eric Roll (The Lord Roll of Ipsden, KCMG, CB); Stephen Moss, Physics teacher at Cherwell School, Oxford; Robert Reid, former head of Science and Features, BBC; George Steedman, lifelong friend and broadcaster BBC; as well as biographers in various dictionaries of science, contemporary thinkers and authors. Last, but most importantly, there is Bronowski’s own contribution written for the Jewish Chronicle as well as a contribution by Elie Wiesel, 1986 Nobel Laureate Peace Prize, survivor of the Holocaust, and author of many books on the Holocaust. All these are listed in the bibliography.

Robert Manne (1998), Associate Professor of Politics, La Trobe University, and public broadcaster, in his review of Saul Friedlander's history *Nazi Germany and the Jews*, accepts that "Friedlander's road to Auschwitz begins with the Nazi onslaught of the Jews of Germany in the early months of 1933 ... By July 1938 a
new wave of violence erupted ... By late 1938 and early 1939, as tension with the Western democracies grew, the idea of Jewish extermination, if it came to war, was already in the air". Manne comments that generally the Holocaust is taken to cover the period 1933 - 1945. Later in chapter 3 of this thesis which considers the Romantic humanist poet and visionary William Blake, I will refer to Viktor Frankl, a survivor of the Holocaust. In the episode Knowledge and Certainty of The Ascent of Man, there are profoundly moving pictures of Bronowski's visit to Auschwitz, as part of his beliefs that humans can seek knowledge but cannot achieve certainty.

Robert Reid, speaking at the first Memorial Lecture to Bronowski in 1978 in Britain, asked: "How to categorize him?", and this is indeed difficult. Bronowski ranged so widely in a passionate expression of his beliefs. Reid comments: "During the past quarter century Bronowski was one of the few figures with roots in the scientific culture who was widely known by his surname only, in the way in which successful musicians Rostropovich, Stokowski, are commonly identified". (Reid, 1978, p94). It was not so much that Bronowski specialized in one thought, such as poetry, scientific ethics, drama, or public education in science. It was more that Bronowski himself was a character. What I mean by this will become clear as this chapter develops. His wife, Rita, his close friends George Steedman, Jonas Salk, and Eric Roll, were just a few of the people who were emotionally, as well as intellectually involved with Bronowski in his adult life. And of course his parents, especially his father, greatly influenced his lifestyle.

Eric Roll wrote that Jacob Bronowski, mathematician, poet, humanist, was born in Lodz, Poland, on the 18th January 1908. Lodz, is in central Poland, about 100 kilometres south west of Warsaw, and was chartered in 500 AD. Since 1820 an extensive textile industry has developed there. Jacob was the eldest of three children and the elder son of Abram Bronowski, the owner of a haberdashery firm which traded between Poland and London, and his wife Celia Flatto. (Roll, 1986, p 93). Moss says: "The family fled to Germany when Russia occupied Poland in the First World War", (Moss, 1997, p 27), and Rita recalled "They were trapped as enemy aliens in Germany during the 1914 - 1918 war. After
difficulties during the war, they moved to London in hopes of reviving his father's import business". (Rita Bronowski, 1983, p223).

Roll takes up the story: "Bronowski was educated at Central Foundation School, London, and then at Jesus College, Cambridge". Rita went on: "Although his given name was Jacob, from the time he became a schoolboy in England, where boys were called by their family names, he was always known as 'Bruno', by friends and family, and then later by fans and taxi drivers. To me he was always Bruno, and even our children use the nickname. It was of course, just the Polish diminutive of Bronowski".

In proceeding further into Bronowski's history there are two quite basic matters to understand as influences shaping his life pattern. In the various biographical reports I have read, these matters do not seem to have been given the attention they deserve in a fuller understanding of the man. One feature is Bronowski's attitude to words, and word patterns, in forming language, especially the English language; the other is his Jewishness, and his relationship with his father.

Firstly, Bronowski's relationship with his father Abram. This is discussed in the 1968 New Year edition of a paper called the Jewish Chronicle. As a background to this, Eli Wiesel in this Jewish Chronicle presents his belief that being a Jew means adventure, a constant questioning. The Jew eludes all theories, all certitudes ... a Jew who works for his people, by that very act, serves the interests of humanity, of which all peoples are presumed to be a part. (Wiesel, 1968, p86). Bronowski's values are not dissimilar. He related, that as a young boy he experienced some conflict with his father, because his father "came from an Orthodox community, and all his life in Poland, Germany, and England - he remained literal in his beliefs and exact in his observations". (Bronowski, 1968, p97).

As Bronowski grew up, he and his father maintained a respect for each other: as Jacob said "Being a Jew meant to me having a profound sense of intellectual values. It meant being tolerant of the thoughts of other minds, not out of indifference, but of respect - above all out of self respect". (Bronowski, 1968, p98). In common with Wiesel, Bronowski characterizes one of the enduring
motivating forces of his life - respect for dissenters, value of intellectual 
endeavour, and a rejection of certainty in favour of enquiry. These beliefs of 
Bronowski find expression in the depth of his studies of the poet William Blake, 
which will form the subject of chapter 3. Bronowski, too, was a "TS Eliot" 
explorer, from early life right through to the end of his days.

Following his account in the 1968 paper, Bronowski discussed his family history 
again. This time it was in a series of twelve short conversations recorded for the 
BBC. The title of the conversations is Voyage around a Twentieth Century Skull, 
with his friend George Steedman. They were 'Bruno' and 'George' to each other. 
Steedman was General Manager of BBC Transcription Services.

Bronowski begins with a review of beliefs held in the nineteenth century which 
shaped the beliefs and values of his mother and father. The Bronowski family 
lived in a ghetto which Bronowski characterized as 'dark'. Both his father and 
mother lived in a universe of "flowing energy" made of "ultimate blocks of 
nature". In common with others, his parents believed there was a world "out 
there" and they didn't realize that the world to be understood "needed an 
understander independent of ourselves". The nineteenth century was the era of 
Charles Darwin: his Descent of Man allowed people to believe that humans 
descended from apes.

![Figure 1.9 Charles Darwin's study at Down House, Surrey, England.](image-url)
The ideas of the revolution in physics - Max Planck's quanta of energy in place of the Newtonian flow, and Albert Einstein's relativity of experience - were yet to come.

Bronowski commented to George, that when the family came to England in 1920, the dark of the ghetto gave way to the "light" of the Western World. Much later when the book The Ascent of Man (Bronowski, 1973, p429) was published, he said "... what I got when I first came to England ... (was) the sense of pleasure with the companionship of civilized minds", and he became over time quite unashamedly an intellectual who valued intellectuals. The other aspect of this quality was noted by Stephen Moss who described Bronowski as "A man ahead of his time", as a public educator using television. Moss said: "Bronowski was one of the earliest to suffer the anti-intellectual attitude many people complain is characteristic of Britain". (Moss, 1997, p27). But this was ahead - in the 1960's especially. I dare say that I and others would suffer the same fate in Australia, if we described ourselves, even in universities as "intellectual". It is a tribute to Bronowski's courage, that he didn't succumb to the suffering.

Returning to his reminiscences of his family in discussion with George Steedman, Bronowski described his mother as a "very free thinker", whereas "my father was not a well educated man, although he was learned in the Old Testament. I had been brought up in a good left wing, liberal household". (Bronowski, 1979). (I think by 'liberal', Bronowski must mean that he and his father respected each other). In the Jewish Chronicle, Bronowski elaborated this relationship when he said: "In retrospect, respect for other human minds seems to be central in Jewish family life. My father did not like my change in beliefs, and I did not like his unchanging ones. But we both knew they were genuinely held ..." (Bronowski, 1968, p97).

Continuing the conversation with George Steedman, Bronowski talked about "tolerance for each other" - father and son - which meant that they both accepted that aspect of Jewish orthodoxy. In Bronowski's words "ethical values of Judaism state people are responsible for each other". This is a source of a passion and a fundamental belief of Bronowski's ethical system, which many years later he
applied in an extended manner to science: "science is more than a technique and more even than a mode of knowledge. It is a critical power in human enlightenment". (Bronowski, 1968, p97).

Later in this thesis, there will be a discussion of science as an ethical system, and the similarity of sciences and humanities as correlated ethical systems.

Further on in the conversation between 'Bruno' and George, Bruno again referring to his father said: "My father was concerned with ethical values; that they are the ultimate ways of doing good, for which you alone are responsible". (Bronowski, 1968, p97).

1.3 Bronowski and his family of origin.

*From their arrival in England, his scholarship in England, his pleasure with the English language, his marriage to Rita Coblitz (Colin).*

By the time the family arrived in England, intact, after their unsettled years in Europe, Jacob Bronowski had acquired two mother tongues, Polish and German, and in a short time one more. As Rita recalled: "Bruno arrived in England speaking not a word of English. He found that learning a new language at the age of 12 was a tremendous experience, especially learning a language as 'precise and cogent', as 'exact and detailed', as English. He fell in love with the English language, and spoke it like poetry. He learned the first steps in science at the same time, and always thought of it as another language. (Rita Bronowski, 1985, p223). Here with the account from Rita, are indications of the passions and beliefs of Bronowski, which the thesis will emphasise as it progresses - namely, poetry and science are both forms of language, which Bronowski himself later asserted are generated from a common creative human imagination. Some hint of this communality emerges with Bronowski's assertion that he presents in his work *The Poet's Defence* as "reasoned as geometry". Both the art of the poet and the art of the mathematician come together in this work.

There is a spirit of delight when Bronowski explained to his friend George Steedman that Poetry excited him so much, because it was English poetry. "English has the marvellous simplicity as science has. English is tight and precise. It is a boney language, not loose and fleshy, (in) its actual shape".
Continuing his "Voyage around the Twentieth Century Skull" Bronowski goes on to explain that it is the pattern of words in English that was so meaningful to him; pattern meaning the shape of words written and spoken, and "the pattern and shape of words allows richness of thought and personal experience. Most of all, English language encourages Imagination". In both the sciences and the arts Bronowski valued patterns and interrelationships between words, symbols, and concepts. Imagination, symbols, and concepts form knowledge. This idea will be considered in some detail in chapter 4 and in fact Bronowski entitled a book *The Origin of Knowledge and Imagination*. His other work *The Identity of Man* also considers these ideas.

Bronowski emphasised his ideas further when he said "Imagination is all science and all the art has the same geometrical quality - relative here becomes more important that absolute, because if you can make an event into a pattern, then you are human". Here Bronowski goes back to link the geometrical relationships of Pythagoras to the freedoms of relativity in the twentieth century skull, and his own specialty of geometry as a mathematician. These topics are given much attention as the thesis progresses, because all these qualities are "species specific" - to use Bronowski's own definition - to humans.

Before leaving the topic of language and returning to the chronology of Bronowski's career, there is an observation by Robert Reid which is interesting. Reid writes: "To see what Bronowski was about needs an understanding of the tools at his disposal. He had a deep concern for the English language, and could use it beautifully". (Reid, 1978, p94). Examples are apparent in Bronowski's style of writing in *The Poet's Defence* and *William Blake and the Age of Revolution*. Reid continues: "It is interesting to observe how this characteristic manifests itself in many writers from Conrad to Koestler whose native tongue is not English". (Reid, 1968, p95). Early in chapter 2 on *The Poet's Defence*, there is Bronowski's own account that as a foreigner from the Continent, when crossing to England on the Channel boat, he knew two words of English, badly pronounced. Reid's observation of Joseph Conrad, Arthur Koestler, and then Jacob Bronowski as a third example, is intriguing, and must surely verify Bronowski's assertion that the English language is a beautiful one.
To continue the chronology. After attending the Central Foundation School, Rita records that Bronowski won a scholarship to Cambridge - Eric Roll confirmed that he was a student of Jesus College to read mathematics - and Rita went on to say that in this heady atmosphere Bruno became the epitome of the Cambridge intellectual in the pattern set at the turn of the century. Many years later - in fact, writing in 1972 - Bronowski himself said: "Cambridge then (1929) was an active, uninhibited, bubbling society of young men who were for ever speculating about everything. I was a fairly inquisitive undergraduate". (Bronowski, 1972, p270). Eric Roll records that Bronowski obtained "his doctorate in 1933, the year he became a naturalized British subject". (Roll, 1986, p93).

After three years of research, Rita said: "It became clear that being a Jew, Bruno would not be made a Fellow of his college", and he decided, to use Rita's expression to "drop out" of Cambridge. Bronowski's speciality from his undergraduate to his post-graduate years, was what Rita termed "algebraic geometry ... topology today". It is worth noting the titles of some of his research papers, since they illustrate his interest in patterns, relationships, words, and his thinking in mathematical concepts. Rita lists some titles: "Curves whose grade is not positive on the theory of the Base" (1930), and her favourite: "The Figure of Six Points in Space of Four Dimensions" (1942). Rita makes special note of another 1942 paper entitled On Cubic Primals in Five Dimensions with Isolated Nodes. (Rita Bronowski, 1985, p223).

Rita Bronowski refers to the complexity of the words used in her husband's research work, as delighting her, but puzzling her, although she herself worked at spatial thinking. She was a sculptor in Britain, said to be of some renown, using the name of Rita Colin. However, despite considerable enquiries at the Art Gallery of W A, the Lawrence Wilson Gallery of UWA, and the Librarian of the TAFE School of Art, I have not been able to find any reference to a sculptor of that name working in Britain in the 1930's and '40's.

When Bronowski was an undergraduate, training in mathematics, he tells in The Poet's Defence that he was already deeply interested in literature, editing a magazine titled Experiment which contained some of the earliest work of future significant literary figures such as WH Auden, (a co-editor of the volumes used
in the next chapter on *The Poet's Defence*), Laura Riding, and Robert Graves. Eric Roll said Bronowski became lecturer, then senior lecturer in mathematics at the University College of Hull, from 1934 - 1942.

Talking to George Steedman, Bronowski on two occasions said that he was asked as a young man by a sculptor known as Rita Colin, daughter of Benjamin Coblitz, furrier, to pose for her for a work that she was planning for a competition. The title of the proposed work was *Portrait of an Unknown Political Prisoner*. With some delight, Rita in 1985 recalled: "It was as a sculptor that I lured the young Bruno to my studio to pose for me. He was glad to have the excuse to pose, but found it boring, and asked for a thick book. I had a collection of William Blake, complete with the prophetic books, on the shelf. He settled into this with some misgivings... At that reading he had a sudden insight into the heart of the man whom he saw to be a true man of his time, a real revolutionary. Bruno rushed off to research the newspapers of the time, and wrote a break-through book called *William Blake, a Man without a Mask*. (In the US, *William Blake and the Age of Revolution*), which had a strong effect on the manner in which William Blake is viewed today". (Rita Bronowski, 1985, p223). I have experienced the excitement and deep insight that Bruno generated in that book, which I hope I shall have conveyed in chapter 3.

Then Rita said: "Bruno and I were married bright and early one Monday morning in 1941 during a daylight air raid on London. We lived in Hull for a short time until we were moved to more secret places because of his war work". (Rita Bronowski, 1985, p223).
1.4 Bronowski, a Cambridge undergraduate and graduate in 1920's and 1930's.

He was deeply affected by the wars of the time – Spanish Civil War, Nazism and shocked by the devastation of Nagasaki when he arrived there as Scientific Deputy to British Chiefs of Staff missions to study the effects of the atomic bombing.

Eric Roll, who first became acquainted with Bronowski, and established their friendship when they were both at Hull, Bronowski teaching mathematics, and Roll, economic thought, said in his reference to Jacob Bronowski in the Dictionary of National Biography, that Rita and Bruno had four daughters, the eldest of whom Lisa Jardine became a Fellow of Jesus College. A nice piece of irony, although her father was made an Honorary Fellow in 1967. There were three other daughters, Judith Jill, Nicole Ruth, and Claire Beth.

I wrote to Eric Roll in 1996 enquiring further about Bronowski's family, and he replied on the 20th February 1997 that Bronowski eldest daughter "Lisa Jardine, (is a) teacher I believe, at St Mary's and Westfield College, London. Although I am not sure about it; sorry I cannot be more helpful". (Roll, 1997, private communication). Eric Roll's reply "Sorry I can't be more helpful", prompts me to say that there appears to be very little known about Bronowski as a person, other than the stories from his wife Rita. In the journal Leonardo, Memorial Lectures,
Rita's contribution was the only personal reminiscence. The several other contributors concerned themselves only with studies of Bronowski's work.

Bronowski himself said he planned to write an autobiography, presumably after his work on *The Ascent of Man* had been completed. But unfortunately this didn't eventuate.

There is a need for a biography similar to Ruth Moore's extensive and very readable biography of Niels Bohr. Moore's work is titled "Niels Bohr, the Man and the Scientist", 1967. From my own studies of Niels Bohr, through Ruth Moore's work I still recall incidents from the life of Bohr and his family, some humorous, some sad, yet overall giving a profound picture of his sense of international responsibility for science. In a recent letter from Dick Gilling, one of the co-producers of *The Ascent of Man*, Gilling wrote "...I was one of the two producers of the *Ascent of Man* series, and knew Dr Bronowski well for some years. I was delighted to hear that someone had taken on the task of writing a serious study of Bronowski's life and work. Rather more than ten years ago, I tried to do so myself, and got as far as renewing acquaintance with Rita Bronowski, but the project unfortunately lapsed". (Gilling, 1998, private communication).

Bronowski had been troubled by the Spanish civil war, and became deeply distressed by Hitler's power and the rise of Nazism in the early 1930's. Robert Manne's 1998 review mentioned earlier, gives some idea of the Nazi impact at the time. As Deborah Straub writes in her thoughtful biographical article on Bronowski: "A mathematician by training, Bronowski like many others was profoundly shaken by the events of World War II, shaken enough, in fact, that he changed the direction of his life. As he once explained to an interviewer: 'Hitler's coming struck a most powerful blow at me and my generation. I suddenly realized that being happy, being human, being a scientist, being with friends, was not enough. And particularly being an academic, which I was then destined to be, was not going to be enough. Quite suddenly it became clear that whatever one did with one's life after 1932 one had to bear witness for what one believed to be the foundations of human decency ... It was no longer enough to be a good person quietly working at your desk ... I realized that I was a persuasive person, that
coming to England, and learning English had given me a gift for the language and for the thought, for the way English people think about themselves and about eccentrics like me which was persuasive to other people. And I never looked back. It was then that I began to write about science in general, to address people who were not in university classes, and to go out to do the kind of work that I became classic for". (Straub, 1983, p95).

Rita confirms Bronowski’s affirmation when she said: "Bruno dedicated his life to the dissemination of knowledge and truth, first as a schoolteacher, and then in ever widening circles as a broadcaster in radio, then television. As a very young man, he would travel miles every week to outlying villages in England to give what were called Workers Educational Association lectures". (Rita Bronowski, 1985, p224). Salvador Luria gives a striking example of Bronowski’s positive influences as a public lecturer in discussion of The Origins in Chapter 5.

These accounts of Bronowski’s working life, from Dorothy Straub and Rita Bronowski set the path for the passions and beliefs of the man during the period 1934 - 1942 while he was at University College Hull.

Figure 1.11 Bronowski’s eldest daughter Lisa Jardine from the cover of her book “Ingenious Pursuits” 1999
A consideration of Bronowski's war work is important because eventually it led him to experience the most profound shock of his life, from which his concern for science and ethics and his need to study 'species specificity' behaviour in human development evolved. All these matters will be considered in due course.

From 1942 right through to 1963, Bronowski remained a government official in his daily work. During the war, he worked for Solly Zuckerman, curiously as Stephen Moss comments (Moss, 1997, p 29), "Who seemed to be unconvinced of Bronowski's abilities ..." The 1994 edition of Encyclopaedia Britannica reports that Zuckerman, originally a research anatomist was called upon (by the British government) to determine the effect on the human body of the shock waves from bomb blasts. He quickly became an invaluable government adviser, with strong views on everything from saturation bombing (which he opposed) to nuclear disarmament (which he endorsed) to environmental pollution".

Eric Roll said that Bronowski's most important work during the war was to develop Operational Research methods, a field in which he was a pioneer. Initially he was with the British Ministry of Home Security, then with the Joint Target Group in Washington D C. David Wren, in his biographical notes, said Bronowski "put his particular training to use, conducting statistical analysis of the effects of bombing" on civilian and industrial targets. (Wren, 1983, p91). In a manner of speaking, Bronowski's special statistical skills caused him to be moved up the scale of the analysis of bombing destructiveness from bombing with conventional weapons to the use of atomic weapons.

To lead up to his visit to Nagasaki in 1945, it is worthwhile to repeat for emphasis, Deborah Straub's record of Bronowski's reaction to the rise of Nazism in the 1930's: "Hitler's coming struck a most powerful blow at me and my generation. I suddenly realized that being happy, being human, being a scientist, being with friends, was not enough. And particularly being an academic, which I was then destined to be was not going to be enough. Quite suddenly it became clear to me that whatever one did with one's life after 1932, one had to bear witness for what one believed to be the foundations of human decency ... It was no longer enough to be a good person quietly working at your desk ..." These statements are so eloquent and profound that they surely have their origins in his
boyhood family relationships; especially his relationship with this father and his learning of the ethical responsibilities to humanity from his understanding of Judaism.

Both as a boy and as a grown man, Bronowski communicates the qualities of the self-actualizing person characterized by Abraham Maslow. This is shown as he moved in the course of his development from the dependent needs of love, belongingness, and esteem - based on others' regard for himself - into the self directed qualities of a man free from enculturation; enjoying spontaneity, with a preparedness to accept the responsibility of Older Brotherliness, the acceptance of problem centring, and the capacity to distinguish means and ends.

As the thesis evolves it will show how Bronowski's sense of creativeness generated a lifestyle with a sense of mission. Bronowski is at one with such men of his generation as Niels Bohr, Albert Einstein, Leo Szilard, Enrico Fermi, in science, and in the arts with the novelist Thomas Mann, and the musician Bruno Walter. Bronowski's abhorrence of violence which led him to write a radio play called *The Face of Violence* was of the kind which so distressed the Spanish painter Pablo Picasso that it moved him to paint *Guernica*. Later, the English composer Michael Tippett wrote an oratorio *The Mask of Time* which was inspired by Bronowski's play *The Face of Violence*.

It was Dorothy Straub's belief that the specific turning point in Bronowski's career came at Nagasaki, Japan, in 1945. Bronowski was Scientific Deputy to the British Chiefs of Staff Mission, "A member of a commission assigned to study the effects of atomic bombing. Bronowski said: 'of course I had seen all the pictures. I had seen all the aerial surveys and I had seen all the stereo pictures, and I thought I knew what it looked like. But coming into that gloomy valley by the sea, with the ships in the harbour, with the broken railways, was an unforgettable experience. I did not know I was in Nagasaki until we were actually at the sides of the ships, because everything was such a tangle of wreckage ... I know that we had dehumanized the enemy and ourselves in one blow. ... I saw how much deeper the implications of great general actions are. And I came back with a totally different sense of how human beings had to react to one another'". (Straub, 1983, p95).
Bronowski may have found reassurance from the depth of his study of William Blake in his 1944 book: *William Blake - a Man without a Mask*. He saw Blake as a visionary able to see the mutilation of men, women and children in the Industrial Revolution of his time - in that period from 1760 to early in the 1800's, and to surmount it with his personal philosophy that man had a vision, which would be thwarted and then regenerate. Chapter 3 will explain the beliefs of Blake, and their relevance to Bronowski, particularly in his revised volume *William Blake and the Age of Revolution*, and demonstrate why I have titled that chapter: *From Peterloo to Belsen*.

Nagasaki would have strengthened Bronowski's ethical values and may well have lifted him from self actualization to experience what Abraham Maslow labels as Transcendence. Of the thirty five meanings of Transcendence and applications listed by Maslow (1971, pp259 - 269), there are two qualities especially relevant to Bronowski's response to Nagasaki. They are 'Transcendence of culture' and 'Transcendence of ego, self, selfishness, ego-centring, etc' (pp260 - 261). The subject of 'Transcendence' is a vital topic in understanding human behaviour beyond everyday life and concerns. In the thesis, the ideas of Transcendence and the psychology of Being are used to understand human behaviour in Bronowski and in the poets Philip Sidney, William Blake and William Wordsworth. Maslow mentions Viktor Frankl, who was an adolescent during his incarceration at Auschwitz, and later wrote a study *Self Transcendence as a Human Phenomenon*. Aspects of the scientist/philosopher Fritjof Capra's thinking in his various works such as *The Turning Point* used the concept of Transcendence in explaining the relationship between Western science and the Eastern philosophy of Taoism. These are a few examples of the wide use of the concept of Transcendence.

Referring to the transcendence of culture, Maslow states: "In a very specific sense the self actualizing man or the transcendent self-actualizing man is the universal man. He is a member of the human species. He is rooted in a particular culture but he rises above that culture and can be said to be the embodiment of it in various ways, and to look down upon it from a height ... I (Maslow) have written about the resistance to enculturation of the self actualizing person. One can
discuss one's own culture in which one is rooted in a detached and objective way of a certain kind ... simultaneously experiencing and self observing one's own experience in a kind of critical or editorial or detached and removed way, so that one can criticize it, approve or disapprove of it, and assume control, and therefore the possibility of changing it exists". (Maslow, 1971, p260).

Bronowski himself gave a splendid example of his personal motivation for transcendence of culture, when he said of his reaction to the Nazi rise to power in 1933: "Quite suddenly it became clear to me that whatever one did with one's life after 1932, one had to bear witness to what one believed to be the foundations of human decency". And as to the transcendence of ego selfishness and self centring, Bronowski surmounted these limitations when he said: "It was no longer enough to be a good person quietly working at your desk ... I realized that I was a persuasive person ..." I have quoted these few lines from Bronowski again, because they seem so fundamental to his belief in human decency, and another example of transcendence of culture.

These values of Bronowski are put in a more general form by Maslow, when he writes that the transcendence of ego, of selfishness, of ego-centring, is when we respond to the demand-character of external tasks, of causes, of duties, of responsibilities to others in the world of reality. When one is doing one's duty, this could be seen to be under the aspect of eternity, and can represent a transcendence of the ego, of the lower needs of the self. These features of the transcendent self have not only been related to Bronowski, but will be discussed in chapter 3 in consideration of William Blake. Now, when they come forward for the first time they are presented as qualities which in one way or another seem to energize Bronowski throughout the rest of his life to grow beyond the shock of Nagasaki.

Rita Bronowski showed how well she understood her husband, when after his war-work she said: "From then on he was a philosopher, humanist, and a sort of evangelist". The Concise Oxford Dictionary defines "evangelist" as "preacher of the Gospel" and Rita's use of the word is interesting given Jacob Bronowski's Judaic upbringing. It supports my belief that Nagasaki caused Bronowski to transcend everyday doctrines, religious or otherwise to preach humanitarianism,
as did such men as Niels Bohr and Albert Einstein, who each in their own way contributed so much to the understanding of quantum mechanics, and hence the development of atomic weapons. The existential paradox of men such as Bohr and Einstein who were peaceful scholarly people contributing to the development of atomic weapons must have promoted Bronowski to devote so much of his later years to emphasizing the ethical qualities of scientists.

From 1945 to 1964, Bronowski remained in England, and as Stephen Moss said: "He had a vocation, however for the philosophy of science and culture. Indeed at this point in his career he might have gained a professorship as the Chair of History of Science at University College, London, was vacant". (Moss, 1997, p27). Now here Moss makes a very pertinent comment about Bronowski, his personality and his future. Since the 1950's, Bronowski had appeared on radio and television programmes providing a kind of week-end activity, even at times when television was a newly developing facility. He was on the BBC's Brains Trust with Julian Huxley, the biologist, and AJ Ayers, the philosopher, and according to Ayers, some people (referring to academics), objected that Bronowski was "too conceited" to fill the Chair at UCL. Others objected to his "histrionic qualities" on TV "which were not appreciated by the academic establishment" (Moss, 1997, p27).

Robert Reid supports this view when he says of Bronowski: "His path through academic mathematics, through government research and development could, at a time when new universities were emerging too thick and too fast, have lead to a comfortable Vice-Chancellorship. He knew it and he was appalled by the prospect. If administration was one of his skills, he had no wish to exercise it at that level". (Reid, 1978, p94). This was what Moss meant when he said: "Bronowski was one of the earliest to suffer the anti-intellectual attitude many people complain is characteristic of Britain". (Moss, 1997, p27).

CP Snow, in the novel The Sleep of Reason (1968), one of the later in the series Strangers and Brothers, portrays a character by the name of Arnold Shaw, who is a Vice-Chancellor in a Midland provincial university established post-war, in place of an "old College of Technology and Art". Shaw is characterized as a rigid, obsessive man. Snow writes of him: "Arnold loved ceremony, protocol,
anything which distinguished one man from another. If the President of the Royal Society came to receive an honorary degree, should he, or should he not, on an academic occasion, take precedence over a viscount who was not receiving a degree?" (Snow, 1968, p103). Bronowski would have been completely out of place in such a world, which fussed over hierarchy and protocol. He would presumably have seen this in practice during his years at Cambridge.

Since he was not a professional broadcaster, Bronowski stayed on in government service from 1950, when as Eric Roll noted "... he applied similar methods (operational research) into industrial problems, particularly when from 1950 he became director of the Coal Research Establishment of the National Coal Board. He played a central part in the development of smokeless fuel". (Roll, 1986 p93). "Bronowski Bricks" as Stephen Moss said they were called. (Moss, 1997, p28). Roll continued: "..." and from 1959 to 1964 as director-general of the Process Development, (Bronowski) was wholly responsible for this aspect of the Board's work". (Roll, 1986, p93). During 1953 Bronowski spent a period as Carnegie visiting professor at the Massachusetts Institute of Technology, where some of his lectures dealt with the two cultures ie the science and the humanities debate, and from these lectures his significant book "Science and Human Values" emerged. CP Snow, in his Rede lecture at Cambridge University a few years later raised a storm of protest from those whom he called "literary luddites" because they eschewed scientific knowledge.

The book *Science and Human Values* is amongst those discussed later in the thesis. Bronowski takes great issue with the old value-free view of science. He found it quite repugnant and believed that it contributed to the irresponsible use of scientific knowledge for destructive purposes.

Bronowski's enthusiasm and passion for the humane relationship between science and art as interrelated, is well illustrated when Deborah Straub recorded this expression of Bronowski's beliefs: "He was firmly convinced that creativity - whether scientific or artistic - springs from the same basic source. Science and art he insisted are wonderful because they both call on imagination, and they both require enormous dedication and integrity ... The wonder of science is reading the riddle of nature. But the wonder of the arts ... is reading the riddle of life, if you
like ... What makes the arts so wonderfully special and so wonderfully human (is) the ability of the human being to identify himself with someone else, and to say 'That is unique humanity, that is what we share and what we try to utter and to invoke at one and the same moment". (Straub, 1983, p98). The word "reading " applied to science, as reading the riddle of nature and the arts, is another special quality of Bronowski's beliefs. He believed that science is a language just as much as poetry is. I recall from my school years the statement: a = 32 ft per second per second and \( v = \mu + a \) t, where \( a \) and \( v \) refer to acceleration and velocity, and see it now as part of the language of science, just as Blake saying: "Jesus is the gentle lamb", or "Urizen is the master craftsman", is a part of the language of poetry.

Throughout the thesis these beliefs will be referred to again and again, and Bronowski's own values are those practical examples found in the study of his works such as The Poet's Defence, William Blake and the Age of Revolution, and The Face of Violence, Science and Human Values, The Commonsense of Science, The Visionary Eye.

Three instances of Bronowski's beliefs which always come to me in daily life are firstly, poems from Sir Philip Sidney: "My True Love Hath my Hart and I have his/ each to the other given", and from William Blake's Auguries of Innocence: "A robin redbreast in a cage / Puts all Heaven in a rage"; and from science: Isaac Newton's formulation \( F = G \frac{m_1 m_2}{d^2} \), the law of inverse squares, which was said to be a topic of conversation among educated ladies and gentlemen in Newton's own time. All three examples are generalizations which emerged from the creative imagination common to the humans who are poets and the humans who are scientists. The two poems are discussed in chapters 2 and 3 respectively.

Everybody surely realizes that Blake is not just writing about birds in a cage, while at least in the 17th century many people understood that the formula of the law of inverse squares referred to the planetary movements and their gravitational interrelationships. The example of robin redbreast is an ethical concern; the example of the law of inverse squares deals with the facts of nature; and they are both expressions of languages. These amazing activities in the arts and the sciences are unique to humans - they are what Bronowski termed "species
specific" and this expression ultimately lead Bronowski to one of the last major developmental shifts in his life: his acceptance of a position at the Salk Institute in California, USA (as described in chapter 4.3).

1.5 Bronowski in England

1945 – 1964 as Chief of National Coal Board. He also appeared on BBC radio and TV.

But there is another noteworthy event in Bronowski's life before to his move to California, which influenced his decision to take up the Salk appointment. Robert Reid discusses this event, and Bronowski refers to it in his conversation with George Steedman in the broadcasts Voyage Around the Twentieth Century Skull. In talking with George Steedman, Bronowski said he had been called to the office of Wilfred Le Gros Clark, and while waiting for Le Gros Clark, he "flirted" with the secretary. Bronowski still enjoyed his memory of flirting with the secretary, and his expression of bubbling enjoyment had the histrionic quality of the actor's expression which, in a man said to be a scientist, the English academic circle did not care for. It is the stereotype perception of the scientist as unemotional and detached, and the artist as emotional and outgoing, that blocks the understanding that science is a language just as much as poetry or music or art.

Robert Reid and Stephen Moss too, refer to the work done by Bronowski for Le Gros Clark, who was a physical anthropologist. During the 1950's there was a "serious dispute among anthropologists using classical as opposed to statistical methods. The argument was over the newly discovered skull of Australopithecus, and whether its teeth were more like those of humans than of apes. Bronowski looked at the statistical methods employed and realized they were quite inadequate, or as he put it 'required additional subtleties'. He therefore persuaded Le Gros Clark to measure some human and ape teeth and was able to use the results to show that Australopithecus was indeed an ancestor of man or a closely related species which had become extinct". (Reid, 1978, p94).

This noteworthy event reinforced the development which had been going on in Bronowski as early as 1952. His wife Rita recorded that when Bronowski wrote: “My ambition has been to write a philosophy for the Twentieth Century that shall
be all of one piece. There cannot be a decent philosophy, there cannot be even a
decent science without humanity. For me, the understanding of nature has as its
goal the understanding of human nature, and of the human conditions within
nature”. Human specificity, as he began to call his subject, was to be the
backbone (even while he was working in the government service in the Coal
Board). “What makes man unique? His ability to change his environment. And
that series of inventions by which man has remade his environment is a different
kind of evolution - not biological - but cultural evolution”. This excerpt from
Bronowski's own thinking and writing was provided by his wife in her analysis of
'Bruno's' own evolution. (Rita Bronowski, 1985, p224).

Chapter 4, is devoted to one of his books The Identity of Man. (1965) and The
Origin of Knowledge and Imagination (1977), will be discussed in chapter 5 and
develops Bronowski's view on the specific human quality of knowledge and
imagination.

In his broadcasts with George Steedman, Bronowski explains his move from
physics to biology, a subject in which he had no formal training. He discusses the
work done by physicists from the early studies by Niels Bohr on the quantization
of the atom, John Cockcroft on the discovery of the neutron, and to Werner
Heisenberg who proposed the Indeterminacy Principle about the influence of the
experimenter as a factor determining the outcome of investigations in atomic
studies. The three names of Bohr, Cockcroft and Heisenberg were the most
significant to Bronowski in his perception of the development of the
understanding of non-living material from hydrogen, to helium, to carbon, which
have relatively simple atomic structures, compared to the complexity of atomic
structures in living material.

1.6 Bronowski’s move to the Salk Institute for Biological Studies.

To develop his “species specific” qualities of humans.

The work of the biologists John Watson and Francis Crick in the 1950's in
understanding the structure of DNA stimulated Bronowski to bring together the
work of the physicists with the newly emerging work of the biologists.
Bronowski's delight was that he was able to integrate in his thinking his mathematical training in geometry, particularly his study of topology, where patterns, shapes and relationships fitted the 'patterns of architecture'. The word 'architecture' relates to topology of living cells, as Rita explained, meaning patterns of molecules in various materials. Talking to George Steedman, Bronowski enjoyed pointing out that ants, which have lived on earth much longer than humans, still rigidly behaved in the ant way. Humans, although more recent inhabitants, are highly adaptable, their molecular and cellular architecture is more complex. The human generates arts, sciences, religions, and philosophies. Shocked by the rigidity of Nazism and other authoritarian cultures of the twentieth century, it was to be expected that Bronowski would understand more of 'human specificity' and its potential for adapting to flexible policies or unnatural rigidities. So Bronowski was drawn from physics to biology, and made the move to the Salk Institute for Biological Studies, his penultimate move.

![Figure 1.12 Bronowski in his later years.](image)

Jonas Salk physician - scientist (1914 - 1995) discussed how he and Bronowski came together. He said: "I first heard of Jacob Bronowski in 1960. My interest was aroused by recognizing the correspondence in his ideas (on science and human ethical values), and what I had in mind in trying to create an institute to heal the separation referred to by CP Snow in *The Two Cultures*." (Salk, 1985, p237).
"Bruno and I had a common interest in the dilemmas with which human kind had long been confronted, and especially since the time of Hiroshima and Nagasaki. Bruno's reports of these events and the consequence thereof, are all well known. For me, one of the motivations for wanting the Salk Institute was to bring together those engaged in science and human values." (Salk, 1985, p238). Salk showed that he was a deeply sensitive man concerned with human wellbeing like Bronowski, when he said: "My mind is haunted with the unanswerable questions of what might have ensued if physicists had been working side by side with others concerned with human values". (Salk, 1985, p238). Charles Snow was expressing the same concern in his lectures on The Two Cultures, when he pointed out that by the 1960's there was sufficient technology available to improve the living conditions of those in the Third World had scientists and men and women engaged in the humanities come together to deal with the Third World's needs.

Salk continued: "The discovery of the structure and chemical nature of the genetic code made clear that it was not too early to bring together under the same institution those concerned with human values and those concerned with living matter ... my thoughts along these lines were encouraged by J Robert Oppenheimer, Niels Bohr, and Leo Szilard, veterans of the revolution in physics that transformed our lives. Could we bring biologists and humanists together in one place for the enhancement each could have upon the other and thereby further guide the course of history? How long could we keep the epistemology of science and the epistemology of human experience apart without jeopardizing our future through failing to realize the importance science and human values have for each other?" (Salk, 1985, p238). Salk's concerns for the welfare of humanity are akin to the humanitarianism that motivated Niels Bohr to establish the Copenhagen Institute in the 1920's. At its peak, before World War II men and women from the physical sciences came from all over the world to Copenhagen to contribute to the ongoing work in quantum physics.

Niels Bohr was a man who would have identified with the values of Jonas Salk. In 1950, Bohr broadcast an Open Letter to the UN in which he sought international co-operation and goodwill in place of the arms race between the US
and the Soviet Union. He concluded his Open Letter urging the UN find "the ways and means of co-operation for avoiding moral menaces to civilization and for turning the progress of science to the lasting benefit of all humanity". (Sarfaty 1993, p172).

![Figure 1.13 Niels Bohr broadcasting the 1950 Open Letter](image)

Bronowski responded to Salk: "You have changed the course of my life ... I would like to become associated with you in your new enterprise". (Salk, 1985, p237). As Rita Bronowski observed: "... the thing that excited Bruno most was that he could learn so much new science in the company of the best biologists in the world". (Rita Bronowski, 1985, p224). It would seem to follow that Bronowski's shock at the destruction at Nagasaki, led him 'to pursue his research into what he called 'human specificity'. By this he meant the attempt to define those particular biological and behavioural characteristics which are expressions of human uniqueness". (Wren, 1983, p92).
Eric Roll records that from 1964 "he" (Bronowski) "became Senior Fellow at the Salk Institute for Biological Studies ... and in 1970, Director of the Council for Biology in Human Affairs" (Roll, 1986, p93).

Bronowski's thinking as a result of his presence at the Salk Institute will be developed at various points in the thesis, particularly in chapter 4, which shows how he evolved his 'constructivist philosophy'. A straightforward example of humans and their species specificity is provided by five lectures given by Bronowski to two young students from universities in the San Diego area. This discussion between Bronowski and the young students, said to have occurred in 1971, and entitled "Ethics for a New Age" states that: all human societies have language; tool making and usage; prohibition on incestual behaviour; rules about sexual attitudes and conduct generally; and rules to govern responses to murder in a group of people.

In a subsequent discussion, Bronowski in his occasionally whimsical, yet perceptive way, commented that humans are the only species who copulate face to face, which is not only a physical characteristic, but allows personal bonding, so shaping social behaviour. This is a clear example of human species specificity.

Bronowski became occupied with fundamental issues about behavioural specifics, and Rita records "working with his colleagues there, one of the problems he pursued was the deeper aspects of the theory of evolution, evolution as an ongoing process. In his paper "New Concepts in the Evolution of Complexity" he put forward a new and original concept of fitness for change that he called 'stratified stability". (Rita Bronowski, 1986, p224). This paper is reproduced in the Leonardo Memorial Series.

Then the ultimate achievement in Bronowski's lifelong struggle to portray the intellectual growth of human culture occurred. To think back to TS Eliot's insight which began this chapter, Bronowski was offered the opportunity "to return where he started" and have experiences in the cultural development of humans in a way which he could "know for the first time". (Eliot, 1944, p43). This was the opportunity offered by the BBC to make the series "The Ascent of Man" in thirteen episodes which was followed by the publication of the book of the same name. At the time of writing The Ascent of Man, there were arguments amongst
academics as to the value of television; contrasting with the BBC's belief in television as a valuable populist activity, and Bronowski's own delight in the proposal of such a series - which was powerful despite his poor health before the series started. However the subsequent and enduring value world-wide of the completed work is now recognised.

1.7 Bronowski Accepts BBC's Invitation to Make *The Ascent of Man*.

Robert Reid, the author, documentary film producer, and former head of Science and Features, BBC television, in the first Memorial Lecture on Bronowski, *Jacob Bronowski - an Appreciation*, in 1978, recreates the excitement and passion that generated *The Ascent of Man*.

"By 1969, therefore, when the BBC under far less financial constraint than it is today, was considering allocating a not inconsiderable fraction of the total annual licence fee to a television series on science. Bronowski was not what might be called the establishment candidate of choice to present the series, nor as it happened, was he the first choice. When it became known that indeed he was under consideration, the academic snobbery which science is still too capable of mustering crawled out of its corner. The message which arrived at the BBC - and there can be no doubt that it represented the view of some serious minded scientists - was that if the BBC was so misguided as to invest such an enormous financial commitment in Bronowski, then it could not expect serious minded scientists to have much truck with the medium in the future". (Reid, 1978, p94).

The attitude which Reid describes here is another instance of Stephen Moss's observation that Bronowski was one of the earliest to suffer the anti-intellectual attitude many people complain is characteristic of Britain. (Moss, 1997, p27).

Reid continued: "I well remember, shortly after Bronowski had been invited to make *The Ascent of Man*, sitting between him and a distinguished author when this subject of return on intellectual capital was raised. The author did not choose to hide how much he despised the academic who wasted significant creative effort on the brash populist medium. What was the point, the author wanted to
know, of spending months in making a television programme, when the few people who mattered would most likely not be watching? The curse of television, he asserted, was its ephemerality". (Reid, 1978, p95).

Reid's continuing observation is quite delightful: "Bronowski suffered fools gladly but he would not suffer foolish ideas. He was fond of quoting his father's advice always to count to ten before answering during a heated argument. But it was precisely during a heated argument that he never remembered the advice. Verbal articulacy and wit are Bronowski's strong points in a cutting fashion. In great contrast to his customary gentleness and humour: he rounded on the author, exposed the snobbery of the argument and tried to explain what he was about and what he believed he could achieve. The passionate way in which these views were expressed took the author by surprise and he subsided into silence and perhaps into considering that, in the face of such brilliantly controlled use of the English language he had best stick to the written word". (Reid, 1978, p95).

What Reid says here about Bronowski's use of the English reflects Bronowski's own description of English as a "boney language" - with patterns which so entranced him.

In the following two chapters, on The Poet's Defence, and on William Blake and the Age of Revolution, there are many examples of Bronowski's use of English in written form. To hear his voice on the television programmes confirms Reid's opinion on Bronowski's suitability for the series.

It is just as powerful to read the book The Ascent of Man and to look at various pictures and photographs, especially in the chapter Knowledge or Certainty where Bronowski is kneeling in the ashes of victims who were destroyed by Hitler's power in the crematoria at Auschwitz.
Figure 1.14 The author at the pond of ashes at the Auschwitz prison camp.
The full title of the series was not *The Ascent of Man* but *The Ascent of Man. A personal view by J Bronowski*. He stamped his own personality on the series.

One reason why I used the word "Panorama" in the title of this chapter is that the study of Bronowski opens so many interconnected spheres of human culture. For example the photograph of Bronowski at Auschwitz relates to the work of the psychologist Viktor Frankl, a survivor of Auschwitz who is discussed in chapter 3, where Bronowski gives an example of the breadth of human sensitivity by the profound nature of his study of the mystic, visionary, and poet, William Blake. Frankl is important because he survived Auschwitz by finding meaning for living within himself through his own personal ethical values, just as Bronowski emphasizes the fundamental importance of ethical principles, the rights of people to dissent, and tolerance for knowledge over certainty as qualities of a good society.
Reid said that *The Ascent of Man* had been widely praised and "has become part of the curriculum of many schools and colleges and it will still be being watched and having influence in years to come". (Reid, 1978, p96). Reid made the point that Bronowski was 62 years of age and "was not in good health" when he started work on *The Ascent of Man*. Bronowski and his talented young film crew "hauling" themselves around the world for three years, "meant there was not much left of him ... and by any reckoning this was a tragedy". (Reid, 1978, p95).

Reid summed up the series by saying "Apart from its content ... in getting across his ideas on science and human values to a vast audience ... the series was a considerable artistic and dramatic success. He made television and science on it respectable. He would no doubt have laughed at the irony". (Reid, 1978, p95).

In the light of recent developments in nuclear arms confrontations evidenced on the Indian sub-continent during May - June 1998, one cannot regard too highly the work of Niels Bohr expressed in his Open Letter, Salk's ideals, and Bronowski's passionate endeavours to integrate science and humanities as expressions of the constructive creative imagination of humans.

To round off this discussion about *The Ascent of Man*, Deborah Straub's reference to *Time* magazine's response is significant. "*Time*, Straub(1983) says: "Referred to the series achievement as an eloquent memorial to one whose singular mission was to democratize the 'aristocracy of the intellect', and help his fellow men strain to hear the thoughts of God". Such is not American hyperbole in the light of the catastrophes of the two world wars in the twentieth century.

There appear to be very few original Australian reviews of *The Ascent of Man*. One reason, provided by the Reid Library (University of Western Australia) librarian is that Australian newspapers reprint syndicated reviews. Dick Gilling (1998) confirms this opinion, when he wrote to me: "I am not at all sure that there are likely to be any proper reviews as even today the Press tends to previews, often uncritically, rather than review".

A review published in the Australian paper *Nation Review*, in October, 1974, the year the ABC first screened *The Ascent of Man*, was titled *Skull Tickler turns smarty fart* by Dennis Pryor. Pryor is largely unimpressed by the twelve (sic)
episodes because he regards it in technique as preceded by the WASP (White Anglo-Saxon Protestant), Sir Kenneth Clark's series *Civilisation*.

But he acknowledges that Bronowski who is more likely to be seen in sports jacket with leather patches on the sleeves "has the gift of a scientist of neither talking down to his audience nor baffleing them with technicalities". Pryor, because he compares *The Ascent of Man* with *Civilisation* (a point Robert Reid said Bronowski emphatically rejected) spends much of his review denigrating the visual spectacle of various events, such as the infant baby getting on its legs and reaching forward to the future adventures of life. Pryor also dislikes the crashing musical chords accompanying scenes of ice age sheets.

Eventually Pryor recognizes Bronowski's belief that, in human society, cultural development depends upon anticipation and imagination. These qualities are implicit in Bronowski's use of the image of the baby struggling to its feet and reaching forward towards experience. This is the ultimate meaning in the title *The Ascent of Man*, although Pryor himself does not give recognition to this.

Dennis Pryor, (MA Canterbury), was before his retirement Reader in Classical Studies at the University of Melbourne. His review of *The Ascent of Man* damns the series with faint praise. Perhaps Pryor has elements of the "literary luddite" referred by CP Snow. The difference in attitude between the literary circle and the scientist as Bronowski knew them at Cambridge, is referred to in more detail early in chapter 2. As to Pryor himself, and his personal history, he gave his recreations, as "Eating, drinking" and presumably had no scientific knowledge in his work.

The newspaper *Nation Review* concluded Dennis Pryor's review with the sketch of Bronowski. The artist was Felix Topolski, from London. The sketch appeared on the back page of the cover of the book *The Ascent of Man*. 

Unhappily, whatever other plans Bronowski may have had after *The Ascent of Man*, his death cut short his intention to write his autobiography. For this and possibly other reasons his personal life is largely unrecorded. One of the difficulties I am occasionally aware of as I write the thesis, is trying to build for myself a more intimate awareness of Bronowski the man. For this reason I have made reference to Bruno's intellectual life in the title of this chapter.
Stephen Moss, writing in 1997 an article entitled The Ascent of Jacob Bronowski, said: "Today it is fair to say that Bronowski is almost forgotten. He is a figure from the '50's, when discussion of the gap perceived between the 'two cultures' of the arts and the sciences were brought out into the open, at least in dinner parties in academic households and is today most strongly through the lecture given by CP Snow which gave the problem a lasting name". (Moss, 1997, p27). Moss acknowledges that we can see now that Bronowski, insubstantial though he may have seemed to the scientific establishment, was a useful figure in intellectual life on both sides of the Atlantic. (Moss, 1997, p29).

I have said on several occasions in this chapter, that the imagination of the artist and the scientist coming from a common human source is essential to generate a world of tolerant, humane people. The inner self and the self that looks out on the world of nature are able to modify, shape and construct this tolerance with generosity on each side, so that there is not the "literary luddite" on the one hand, and the unimaginative scientist of limited outlook on the other, which CP Snow discussed in 1958.

Bronowski would have wanted both the artist and the scientist to accept Oliver Cromwell's plea when each side takes up opposing positions: "I beseech you in the bowels of Christ, think it possible that you may be mistaken". (Bronowski, 1975, p374).

Bronowski's beliefs are also related to the complementarity principle of Niels Bohr - opposites are complementary - or as phrased by a biographer of Bohr, Abraham Pais, Niels Bohr said that whenever you come with a definite statement about anything, you are betraying complementarity. (Sarfaty, 1993, p77). Fritjof Capra has long held the belief that "clearly the modern concept of complementarity is reflected in ancient Chinese thought, a past which a made a deep impression in Niels Bohr". (Capra, 1983, p68). It is a source of comfort to me to be aware that modern science as expressed by men like Bohr and Capra and Salk and Bronowski, is so much more sensitive and subtle than the simple cause effect ideas of earlier science.
Stephen Moss concluded on a optimistic note, when he said: "Bronowski was an eighteenth century man filled with optimism and a delight in the human race that was rare in the twentieth century. If he failed in achieving his aims ... 'to create a philosophy for the twentieth century which shall be all of one piece', to use Bronowski's own words, it is perhaps because he was a little premature". (Moss, 1997, p29).

If Moss is correct in his assessment, then it is more important to explore and present the passions and principles of Bruno's life. It is the purpose of this thesis to try and fulfil this obligation.

David Wren's assessment was: "While it has not gone undisputed, his position is given considerable weight by the force of both Bronowski's argument and example." (Wren, 1983, p92).

In recognition of the force of Bronowski's intellectual struggles the next chapter begins with lines from William Blake's prophetic work "Milton" in which Blake, describing the struggle for religious tolerance and generosity of outlook, includes a line in that poem "I will not cease from Mental Fight".

Nor did Bronowski.
Chapter 2: As Reasoned as Geometry

Bring me my bow of burning gold
Bring me my arrows of desire
Bring me my spear! O clouds unfold
Bring me my chariot of fire

(Blake, in Bronowski, 1958, p162).

2.1 As Reasoned as Geometry

While at first sight, the title I have chosen for this chapter As Reasoned as Geometry may seem to be at odds with the four lines from William Blake, there is no contradiction.

The statement As Reasoned as Geometry comes from a discussion by Bronowski in the Foreword to his first book The Poet's Defence. This book is the subject of this chapter. In the Foreword Bronowski explained that he had tried to write The Poet's Defence, free from literary tricks and vague literary words like "Value, Form, Content". (Bronowski, 1939, p8). He said he especially avoided what he called "donnish histories ... And I have kept it free of the other outfits of scholarship. Lists, notes, likenesses, debates with critics". (Bronowski, 1939, p6).

It is clear that Bronowski was very impressed with the head-to-head encounters by students and teachers in science, which he recounts at the end of the 1966 edition, compared with talk, so to speak, of students and teachers in literature. In the body of this chapter I allow Bronowski the opportunity to explain his beliefs and experiences when he was at Cambridge University.

When I first read The Poet's Defence, it was a publication in a small, plain, unadorned book. (Bronowski, 1979). I was puzzled as to why Bronowski, a mathematician, with special interests in topology and statistics, would want to write a book, not so much about poetry, but about what selected poets themselves had to say about their poetry. Eventually, I came to develop personal relations with the poets - the charm and moral values of Sir Philip Sidney, the earthiness of John Dryden writing about political and religious conflicts and the State and the sensitivity to human life of William Wordsworth, to mention just three.
I read the Preface to the 1966 edition, which contained Bronowski's, if not discontent for teachers and students of poetry, then his disapproval of their failure to involve themselves personally in their studies. I realized that Bronowski's phrase As Reasoned as Geometry was an expression of his own personal integrity and ethics, letting selected poets explain themselves in an orderly way, and doing justice to their original work, and the labour required to do it. As the chapter progresses, the emphasis put on poetry as an ethical process given to Truth, will be seen to be a basic belief of Bronowski.

Finally, I came to read the 1939 edition, the original edition of The Poet's Defence and the 1966 edition as well. I realized that Bronowski was passionate in the task he had set himself, i.e. to show poets as people who communicate their inner selves, and thus their work has the quality of universal, absolute, direct knowledge.

I chose the four lines of poetry from William Blake's prophetic poem Milton to head this chapter and a line from the same poem to conclude the previous chapter. The powerful imagery of the line: "I shall not cease from mental fight", and the four lines that begin this chapter fit Bronowski in his personal way as a man with a mission. His mission was to struggle to convey timeless knowledge, just as much as Blake wanted to urge humanity to rise above everyday issues, and fight for the good values of truth, justice, and dignity over the destructions that developed from the Industrial Revolution.

In this chapter I will let Bronowski explain the poets as he regarded them, and make my own comments and assertions on Bronowski's work as the occasions arise. When there is a selection of lines of poetry, from a particular poet, there will be the bibliographical reference in the following way: poets name, anthologist's name, date of publication, and page number. For example: the poem from Sir Philip Sidney: My true love hath my hart (Sidney, in Auden and Pearson, n.d. vol 1 pp497-498).

The lines from William Blake's poem Milton, (Blake, in Bronowski, 1958, p162), could well have been the 'leit motif' for Jacob Bronowski. To know that Bronowski was a passionate man, one had only to look at him crouching in a
pool of the ashes of his Jewish relatives who perished in the Nazi crematoria at Auschwitz (Bronowski, 1973, p375). He could well have cried "O clouds unfold" when he pleaded for humans to give up the desire "for certain knowledge". In the same vein Bronowski quoted Oliver Cromwell, speaking to a kirk in Scotland in the 17th century. "I beseech you in the bowels of Christ, think it possible you may be mistaken" (Bronowski, 1973, p374).

This thesis will show how passionate Bronowski was about his belief that the creative imagination generates knowledge in both the humanities and the natural sciences, and his ethical principles or values summarized in one of his 'arrows': "We ought to behave in such a way that what is true can be verified to be so" (Bronowski, 1961). Another 'arrow' which characterized Bronowski's beliefs and values is: "Truth is the ideal and dignity is the search for its fulfilment" (Bronowski, 1944, p206).

Although Rita Bronowski refers to her husband's lack of knowledge of the English language when he arrived in England, Bronowski himself wrote: "I came to England when I was twelve, and when I landed (from the Continent) I could speak, rather badly, two words of English, which I had learnt on the Channel boat" (Bronowski, 1944, back cover). Having won a scholarship to Cambridge University, where he graduated as a mathematician, Bronowski published his first book of letters, The Poet's Defence in 1939. As he said "like my friend Charles", i.e. CP Snow, Bronowski, during his years at Cambridge, moved in both literary and scientific circles. Reading his account of his experiences at that time (Bronowski, 1966 p viii), there is a striking similarity in their perceptions of The Scientific Revolution and the Two Cultures (Snow, 1959), which was the title of Snow's Rede Lecture.

Snow characterized the literary people as scientific "luddites", and at the same time warned the scientists of their "impoverished imagination", through their rejection of literary experiences. Bronowski wrote of his perceptions of scientists and those of the literary circle in the 1966 preface of The Poet's Defence. It is important to quote his own words because they explain how he came to write such a no-nonsense, intense and complex book about eight "admired" poets of the English language (Bronowski, 1966, pxi). There is a touch of sarcasm in
Bronowski's use of the word "admired", because the eight poets in the book are all highly regarded by literary people. The sarcasm may have been an instance of an over-confident young man as Bronowski was when he wrote the book.

He says "the problem" (of criticism) "that had been borne in on me since I was an undergraduate can be set out quite simply. As a mathematician I had, of course, spent much time in the company of scientists. They talked vigorously about scientific work, their own and that of others, and past as well as present ... . What they had to say was always personal and direct, the talk of active men who worked in the same vein as their heroes ... . They spoke as equals about the labour of turning into fact what the imaginative mind conceives" (here is an early fundamental belief by Bronowski that runs throughout his future life work), "and they spoke about the labours and minds of the great and the small as if they were their own, from the inside. No doubt what they said was often callow, but it was never magisterial. No one ever thought of laying down the law to other scientists. To be a critic was not and is not part of the scientific profession" (Bronowski, 1966, pviii).

But Bronowski had also edited a literary magazine at Cambridge, (called *Experiment*) "and had talked in the same way to those who wrote and read it. Here the tradition was subtly yet wholly different. There was a respectable place for the critic as critic, and from the outset those who wrote as well as those who read, were content with that. They crowded the lectures of IA Richards", (a pupil of Samuel Taylor Coleridge), "and later of FR Leavis (known for his ascorbic reaction to CP Snow's charge of literary people as scientific "luddites"), "and then went home to analyze poems in the manner of the master. And although the master's analysis was indeed searching, it was by nature the method and analysis of the outsider". (Here again is another arrow or theme belief from Bronowski). "It never gave the hearer the sense that he ought ask himself how he would set about putting his own thoughts into a poem. Did the critic ever think about which of HIS (Bronowski's emphasis) were fitted to go naturally into a poem? Could they by nature go into anything else? And if not, what did he do with the thoughts that poets made into poetry. How did poets come to dredge out of their heads the stuff that makes poetry and, they believe nothing else?" (Bronowski, 1966, pviii).
Many years after Bronowski made these observations, he recalled in a discussion with George Steedman entitled *Voyage around a Twentieth Century Skull*, attending a ceremony at Cambridge University about 1932, at which on the same platform at the same time Albert Einstein the scientist, and W.B. Yeats the poet, both Nobel Laureates, were awarded Honorary Doctorates. This seems to suggest that over time Bronowski had moved much closer to his belief that the creative imagination which produced knowledge in the humanities and the sciences was not dissimilar, and that knowledge in the sciences and the humanities is generated by the same creative imagination.

From the two contrasting castes of mind between the scientific and the literary thinker, Bronowski characterized scientific knowledge which is never true, but near-truth, with knowledge of the poets which is true, meaning that poetry is *a priori* universal, direct and absolute knowledge. Such a bold statement is again characteristic of Bronowski's beliefs, and at first glance is too sweeping to be valid and seemingly in too strong a contrast to the claim of near-truth in scientific knowledge. For the moment, let it be said that the expression *a priori* is not used in a traditional philosophical sense, but more in the existential way that AH Maslow, uses the expression (Maslow, 1971, pp55-92). In his chapter on creativeness Maslow discusses the *a priori* attitude "necessary for perceiving or understanding the full concrete richness of the matter-in-hand, in ITS (sic) own nature and in ITS (sic) own style without our help, without our imposing ourselves on it ..." (Maslow, 1971, p65). This is another 'arrow' which Bronowski fires from the "bow of burning gold" and is seen to be related to his concept of the creative imagination.

Bronowski regards poetry as expressing the "urges of passion ... part of the steady state of the mind ... in all societies" (Bronowski, 1939, p14). Poetry is the most suitable art form to communicate the inner self. What distinguishes the best of the poets, those such as the Elizabethan Sir Philip Sidney, and the Romantic humanist William Wordsworth, is that they bring their whole person to absorbing and then expressing their understanding of human affairs. It is the preparedness of the poet to open himself out to experience that Maslow refers to as creative behaviour, and I understand Bronowski to mean by *a priori* knowledge. It is not *a*
priori knowledge in the Platonic sense of the person born with knowledge which unfolds during a lifetime, but rather a priori as meant by the modern humanist psychologist Abraham Maslow. It cannot be said too often that Maslow's a priori respectful receptivity, Carl Rogers' unconditional positive regard, and Fritjof Capra's advocacy of the Taoistic attitude of passive receptivity to experience, all align themselves with Jacob Bronowski's openness to the poetic experience.

In his usual succinct manner, Bronowski asserts at the time of writing The Poet's Defence, "the rules of reasoning are part of the steady shape without which the mind cannot be. For formal logics may change, but the rules of reasoning are steady now as in Egypt, and here now as in Greenland. The urges of passion are part of the steady state of the mind. All these are true in all societies. They made an absolute truth, which I think is the truth of poetry" (Bronowski, 1939, p10).

In the light of this style of thought and belief by Bronowski, and remembering that his profession at Cambridge was that of a mathematician, it is not unexpected for him to say: "I have tried to write criticism as reasoned as geometry" (Bronowski, 1939, p8) and to note "I have kept this book free of donnish histories of such borrowings" (referring to his desire to let poets speak for themselves). Further Bronowski wrote: "And I have kept it free of the other outfits (footnotes, lists etc.) of scholarship" (Bronowski, 1939, p6). These are the assertions of a man of integrity about his purpose to present the humanity of the true poets, as discussed in the introduction to this chapter. It also supports Bronowski's sensitivity to English as a "boney language" with distinctive word patterns.

Against such a background of beliefs and values, Bronowski studied eight poets from Sir Philip Sidney (1554-1586), to William Wordsworth (1770 - 1850) to WB Yeats (1865-1935). At the end of this chapter I have made a simplified chart of the territory covered in studying Bronowski's beliefs. The scheme of the chart relates to Bronowski's assertion that as science has risen in society in significance as a social standard, so the dignity of poets as offering universal, absolute and direct knowledge, and their significance, has declined. If a car, a tube of toothpaste, or a can of food, is said to have passed 'scientific' tests, then the
community regard it as trustworthy. I suspect poets in our times in the late twentieth century are regarded as irrelevant in establishing our societies' goals.

In presenting Bronowski's beliefs about the value of letting the poets speak for themselves through their defences, I have used examples of the poetry from the eight poets, some examples direct from The Poet's Defence (Bronowski, 1939, 1966). The selections from the work of poets in the volumes of Auden and Pearson (n.d.), Hamilton (1994), and Yeats (1996), are my personal choices, as I have explained earlier.

This chapter presents Bronowski's belief that poetry tells the truth through universal, direct and absolute experience, and the examples combine Bronowski's responses to the poetry and my personal reactions to the poets, which support Bronowski's belief, and at times soften his austere style.

2.2 Sir Philip Sidney

Sir Philip Sidney, Elizabethan poet, soldier and courtier, Bronowski characterizes with the complimentary expression, "gallant" (Bronowski 1939, p 19). Amid the manipulations and the magnificences of Elizabeth I's court, and the extravagances of the ideals and actions of the Elizabethan Age, such as the adventures of Sir Francis Drake and his voyages, and defeat of the Spanish Armada, and especially the pursuit of the legendary El Dorado, Philip Sidney stands out as a poet of Virtue, the Ethical Good Conduct of the universal, direct and absolute experience of the poet.

Bronowski describes Sidney as an Elizabethan gallant with the "graces of humour and liveliness ... a man of uncommon delights, eagerness and single mind" (Bronowski, 1939, p19).

In his essay on Sidney, Bronowski studies his Defence of Poesie by offering the conflicting views of Stephen Gosson and Sidney, analyzing the arguments in Bronowski's manner as "reasoned as geometry" (Bronowski, 1939, p8), to bring out the qualities of Sidney's Virtue and Gosson's Puritanism. It is a very careful presentation.
Gosson, known as an Elizabethan Puritan, produced a pamphlet *Schoole of Abuse* in which he attacked the plays and the playhouses of his time. Gosson included a reference to poetry, charging that poetry is "amorous, and wasteful, frivolous and of no consequence". He objected to poetry because it aroused the "fever of the senses", and that poets "lived longest in those pointes that profit least. Men gained nothing from reading poetry, and poetry in mastering them, overthrows their knowledge of virtue" (Gosson, in Bronowski, 1939, p23).

Sidney, then a young man of 29, "a man of uncommon delights" as Bronowski characterized him, felt obliged to respond to Gosson, in 1583. Gosson regarded poetry as "serious" business. There was for him, the Ideal Good to shape right behaviour. The Ideal Good was quite untouched, more so was untouchable, by everyday affairs and actions. Poetry is best seen in the Bible, which had to be selected and read in the rigidly strict Puritan manner, because if Gosson's Ideal Good was touched by human affairs it would be sullied. Gosson placed the Ideal Good beyond human activities.

In any event, poetry should follow past practices, and compose verse about warriors in ancient times. Gosson wrote: "The right use of auncient Poetrie was to haue notable exploytes of woorthy Captaines, the holesome counceles of good fathers and vertuous lies of predecessors set downe in numbers, and song to the Instrument at solemne feastes, that the sound of one might draw the hearers from kissing the cupp too often; the sense of the other put them in minde of things past, and chaulk out of the way to do the like" (Gosson, in Bronowski, 1939, p25).

Put simply, Sidney's theory which shows that in some respects it relates to Gosson's, is that "our erected wit maketh us know what perfectio is, and yet our infected wil keepeth us from reaching unto it" (Sidney, in Bronowski, 1939, p39).

The meaning of the terms "erected wit", "infected wil" and "perfectio" mean the Ideal Good, the senses, and the perfection or abstinence from daily affairs. But Sidney's reply to Gosson is based on the word Virtue which encompasses a complexity of human activities. It does not mean, as the word Virtue suggests, Chastity, but is an Ideal of Good Conduct, where the Soul is a Godly feature of
Good Conduct, and the mind is the interactive process between Good Conduct and social living. Sidney acknowledged the Gosson Ideal which would become sullied by human contact, but Sidney recognized that what Gosson proposed was not possible in daily life, especially as Sidney saw life at the Elizabethan court.

Sidney proposed a compromise: that while human life did sully the Godly Virtue of Good Conduct, the aim always was to live in such a way that living did the least damage to Good Conduct. Sidney wrote a poem "Astrophel and Stella" to illustrate the idea of the divine soul by the godly Stella, a model of Virtue. Rather than use that poem to illustrate Sidney's thinking, here is an explanation of erected wit, perfectio, and infected wil from his "The Defence of Poesie". Sidney writes: "Neither let it be deemed too saucy a comparison, to ballance the highest point of mans wit, with the efficacie of nature: but rather give right honor to the heavenly maker of that maker, who having made man to his owne likenes, set him beyond and over all the workes of that second nature, which in nothing he sheweth so much as in Poetry; when with the force of a divine breath, he bringeth things foorth surpassing her doings: with no small arguments to the incredulous of that first accursed fall of Adam, since our erected wit maketh us know what perfectio is, and yet our infected wil keepeth us fro reaching unto it" (Sidney, in Bronowski, 1939, p36).

Sidney here is addressing an eternal issue. It is akin to William Blake's notion of man's vision and vision thwarted, to be dealt with in the next chapter; it is like Bronowski's own plea to free ourselves from the desire of seeking certain knowledge, which he so poignantly expressed in the Ascent of Man; it is like the struggle of Niels Bohr to create an international community to manage nuclear energy and guard against the risk of its use for destructive purposes; and it is not unlike Picasso's painting of Guernica, where he so powerfully shone an electric light representing mechanical science on the horrific destruction of human life from the Nazi bombing during the Spanish civil war. People strive to reach ideals of honour, virtue, brotherly goodwill - and always there are the intrusions of machinations of daily life. It is this that Sidney had to contend with, against Gosson's Puritanism, which does not allow any influence of the excitement of the senses.
Importantly, because it illustrates the worldly-wise, good sense of Sidney, he asserted that at right or at appropriate moments in society the Godly Ideals of Virtue can flash over into right social conduct to be a benefit of society. This is an expression of the generosity of spirit of Sidney, and testifies to the quality of his educated sensitive mind.

The problem of the erected wit or Godly Ideal or Virtue of behaviour, and its relation to the 'wil' or pull or push of the senses, has gone on since Sidney's time. Bronowski's passion for William Blake deals with Blake's philosophy of self fulfilment centred about the concept of man's vision and vision thwarted, an arrow of desire in the Bronowski armamentarium. This struggle is a basic issue in Bronowski's own life, and will be elaborated as the thesis progresses. To put into words one of the "arrows of desire", is Bronowski's injunction "we ought to behave in such a way that what is true can be verified to be so" a central statement in his later study *Science and Human Values*.

![Figure 2.1 Sir Philip Sidney, with his sister Mary, Countess of Pembroke.](image)

Returning to the discussion of Sidney, Bronowski observes that Sidney's friendship with his sister Mary, Countess of Pembroke and their mutual friends led to Sidney "packing into the one word" (Virtue) "a state of mind which is
complex and which is the model of the Renaissance thought which dealt with the broad issues of mind and body relationships" (Bronowski, 1939, p47).

In Chapter 1, examples were given from the humanities and the sciences in our own time, of the struggle to find harmony between mind and body and the consequences when the body gets out of hand over the mind. Just one further example before returning to a consideration of Sidney's Virtue: on page 346 of Bronowski's 1973 edition of The Ascent of Man, he provides a photograph of Enrico Fermi and his colleagues at the University of Chicago. Enrico Fermi, with his Jewish wife Laura, left Mussolini's Italy and settled in America. Fermi, a man of good spirit and outlook, developed the atomic pile at the University of Chicago, which eventually led to the creation of atomic bombs (Bronowski, 1973, p346). The intellectual brilliance of the atomic scientists like Niels Bohr and his young friend Werner Heisenberg, who from the freedom of discussion at the Copenhagen Institute in the 1920's eventually led, with Fermi and others, to the emergence of the Manhattan Project where the first bomb was tested at Los Alamos on the 15th July, 1945. We have indeed come a long way from Gossen's Puritanism and Sidney's Virtue over the centuries, technologically, if not, ethically.

In relation to ethical matters, an appreciation of Sidney's Virtue, Infected Wil, expressed in his astute perception of human life, is provided by a selection of his poetry from Arcadia. The ethical issues of good and evil, love and envy, openness and meanness, but with the overall essential generosity of spirit of Sidney as the poet of universal, direct, and absolute experience, are always apparent.

_My True Love Hath My Hart_

_My true love hath my hart, and I have his,  
By just exchange, one for the other giv'ne.  
I holde his deare, and myne he cannot misse:  
There never was a better bargaine driv'ne._

_His hart in me, keepes me and him in one,  
My hart in him, his thoughts and senses guides:  
He loves my hart, for once it was his owne:  
I cherish his, because in me it bides._
His heart his wound receaved from my sight:
My heart was wounded, with his wounded heart,
For as from me, on him his heart did light,
So still me thought in me his heart did smart:
Both equall hurt, in this change sort out blisse:
My true love hath my heart and I have his.


The first two lines of the second stanza: “His heart in me, keepes me and him in one, / My hart in him, his thoughts and senses guides:” delicately express Bronowski's belief that sensitive relationships between people depend upon the capacity to see each in the other, so then we know how our conduct affects the other. As Sidney says: "There never was a better bargain driv'ne", and such a quality in the relationship between the two lovers allows them to survive wounding experiences.

This poem surely communicates beyond particular lovers to the universal absolute and direct experience of all loving relationships between people, which relates to the ethical values of human affairs beyond the here and now. It is the "being cognition" (Maslow, 1971) of the poet who responds with the whole of his individual self allowing him to transcend the here and now, the timely and enter timeless experience. This last phrase "the timely, and the timeless" is one of the essential qualities of William Blake, to whom Bronowski devoted himself in his 1944 book. These qualities formed part of Bronowski's studies into 'human specificity' when, years later, he went to the Salk Institute.

By way of contrast to "my true love hath my hart", there is Sidney's poem Loved I am, Yet Complaine of Love which communicates the person who feels deprived in the satisfaction of belonging to other people, organizations, or society at large. Such a person unsatisfied, or dissatisfied, feels hurt, and hurts others in return.

Four centuries later, Maslow characterized such people as 'deficiency motivated' and 'unable to express themselves as generous human beings'. (Maslow, 1971).

An extract from Sidney's poem is:

Loved I Am, Yet Complaine of Love
Loved I am, yet complaine of love:
As loving not, accus'd, in love I die.
When pittie most I crave I cruell prove:  
Still seeking love, love found as much I flie.  
Burnt in myself; I muse at others fire  
What I call wrong, I doo the same, and more:  
(Sidney, in Auden and Pearson, vol I, p497).

As with My True Love Hath My Hart Sidney describes the dynamic movement between people, a feature of Bronowski's constructivist philosophy, which will be developed later. When Bronowski wrote his award winning radio play The Face of Violence, shortly after World War II, he too communicated the same belief as Sidney that people need respect and recognition; and if these qualities are not forthcoming, then hurtful, aggressive behaviour results. This links Sidney to Blake who strongly believed that the good society was only the means or condition for good people to emerge. The timelessness of these words comes to mind again when we think about the failure of the French revolution and the failure of the Russian communist revolution in our own time. They were means not ends for good people, and they failed because they were presented to the people as ideals without regard for the understanding of human needs of food, shelter, security, and belongingness.

Sidney points to some measure of balm for wounds in deficiency motivated people in the poem Get Hence Foule Griefe:

Get hence foule Griefe the canker of the mind:  
Farewell Complaint, the misers only pleasure:  
Awayayne Cares, by which fewe men do finde  
Their sought-for treasure ...  
But thou sure Hope, tickle my leaping heart  
Comfort, step thou in place of wanted sadness.  
Fore-felt Desire, begin to savour parts of coming gladness.
(Sidney, in Auden and Pearson, Vol 1, p498).

Hope requiring openness to experience, replaces "Complaint, the misers only pleasure". Poetry of this quality requires sensitivity to oneself, ie. the poet and others at the universal, absolute and direct level, the Being cognition level where deficiency needs are not present to interfere with the openness to human experience.

As a foretaste of Blake to come, a few couplets from his Auguries of Innocence show the same quality:
A Robin redbreast in a cage
Puts all Heaven in a rage.
A dovehouse fill'd with Doves and Pigeons
Shudders Hell thro' all its regions
A dog starv'd at his Master's gate
Predicts the ruin of the State

From the same Auguries comes this intensely powerful couplet:

A Truth that's told with bad intent
Beats all the Lies you can invent.

(Blake, in Auden and Pearson, Vol IV, pp18-19)

An easy reading of Sidney's poems from Arcadia could leave the impression that all he is doing is being an early literary psychologist, commenting on human relationships. Such a superficial reaction could undermine Bronowski's justifiable claim that Sidney began the move to regard poets as special people offering Truth about human ethics in a way that is universal, direct, and absolute. Because it is so important to my perception of human life, the thesis focuses on these three qualities. The depth and sensitivity of Sidney's writings does cross cultural boundaries, and this is well illustrated by O Sweet Woods. This poem includes the lesser or baser human reactions as well as those of kindliness, courtesy, and generosity towards other people.

O Sweet Woods is such an intense poem that it merits quoting in full:

O sweet woods the delight of solitarines!
O how much I do like your solitarines!
where mans mind hath a freed consideration
of goodnes to receive lovely direction
Where senses do behold th' order of heav'nly hoste
and wise thoughts do behold what the creator is:
Contemplation here holdeth his only seate:
Bowned with no limits, borne with a wing of hope
Clymes even unto the starres, Nature is under it.
Nought disturbs thy quiet, all to thy service yeelds
Each sight draws on a thought, thought mother of science,
Sweet birds kindly do graunt harmony unto thee,
Faire tree shade is enough fortification,
Nor danger to thy self if be not in thy selfe.
O sweet woods the delight of solitarines!
O how much I do like your solitarines!
Here nor treason is hidd, vailed in innocence,
Nor envies snaky ey, finds any harbor here,
Nor flatterers venomous insiminations,
Nor comming humorists puddled opinions,
Nor courteous ruin of proffered usury;
Nor time prattled away, cradle of ignorance,
Nor causeless duty, nor comb of arrogance,
Nor trifling title of vanity dazleth us,
Nor golden manacles, stand for a paradise,
Here wrongs name is unheard: slander a monster is
Kepee thy sprite from abuse, here no abuse doth haunt;
What man grafts in a tree dissimulation?

(Sidney, in Auden and Pearson, Vol I, p499)

Sidney's insights in this lovely poem speak for themselves. They are still relevant to life in our times. The first stanza could well be used by conservationists in our century as justification for the preservation of the natural forests and the value of the wilderness. The second stanza is as powerful and in marked contrast to the delights of the forest. It deals with the machinations and power and manipulations that Sidney must have seen about him at the Elizabethan Court. It is Sidney's quality of seeing both good and evil in men and women that makes him such a timeless poet.

Before leaving Sidney to consider the next of the poets in the series, I question what appears to be a puzzling feature of Bronowski's study of the emphasis that Sidney places on Ethics. Bronowski values the 'Erected Wit' or 'Godly Virtue' in Sidney, but he seems not to pay attention to the earthy side of life as Sidney portrays it. Bronowski's emphasis on Ethics at the expense of what Sidney calls the 'Infected Wil' or the social side of life, was perhaps because he was too inexperienced within himself to accept the broader features of life, or perhaps he was still strongly influenced by his early upbringing in Judaism as imparted to him by his father. This may have made him somewhat narrow minded in his outlook.

Bronowski's concern with ethics is not to be deplored, but when he writes of Sidney, his sister Mary, and their friends "packing into the word Virtue a state of mind which is complex, which is a model of Renaissance thought, which dealt with the broad issues of the mind body relationship" (Bronowski, 1939, p47), he does not go further and acknowledge that this is a powerful statement about human potential as it evolved in the intellectual thought in the western world of the future. Bronowski seems to encounter this issue within himself again, when
he takes the poet Wordsworth to task. William Wordsworth enjoys pleasure in
the passions of poetry and his perceptions of life are broad and expressed with
great empathy to the various qualities of Nature and human life. Perhaps
Bronowski's intellectual struggle emphasized the Rational or Godly too much, at
this early phase of his life.

In *The Poet's Defence* Bronowski next contrasts Sidney with Shelley. He
acknowledges the time span of 250 years between Sidney and Shelley to show
how poets have declined from the inner ethical perceptive qualities of universal
absolute and direct experience, to what he calls social psychological concerns, the
result of the impact of science in its dealings with empirical natural knowledge of
nature. Shelley will be discussed later and, then it will be seen that Bronowski is
all but dismissive of Shelley's "love thy neighbour" attitude.

For the purpose of the present discussion, let us leave Shelley and turn to
Bronowski's consideration of John Dryden who was, in many respects a poet of
ethical quality to set alongside Sir Philip Sidney. But, in other respects Dryden
begins the change from the ethical inner universal absolute direct sensitivities of
the poet, towards the Nature poetry of William Wordsworth, and on to Samuel
Taylor Coleridge, and then the "mock idealists" of Swinburne, and Yeats. It is not
too strong to say that the use of the word Nature, in Dryden's poetry, accounts for
Bronowski's belief in the decline of poetry from Sidney to Wordsworth.
Bronowski considers that despite Dryden's ethical qualities, that poet's use of the
word "nature", even when the word means the ethical quality root passion of the
mind, begins the decline in the significance of poetry as an ethical experience.

2.3 **John Dryden**

Even so, John Dryden (1631 - 1700) was a man of significance to Bronowski's
arguments about poetry and the natural sciences. Dryden was a member of the
Royal Society at the time when its President was Sir Christopher Wren, an
Architect. The significance of the two appointments was that Dryden and Wren
were practitioners in the arts and humanities, yet held posts in a scientific
organization. In other words science and arts came together.
Bronowski regards the presence of John Dryden the poet, and Sir Christopher Wren the architect in the Royal Society as an instance of the compatibility of the scientific thinker with the artist's imagination. This is a recurring theme in Bronowski's beliefs, and is another instance of Bronowski, the mathematician, scientist, humanitarian, historian, being aligned with colleagues in the humanistic sciences like Abraham Maslow. Both were careful to emphasize that their studies of human and scientific activity shared the common feature of empirical processes in their work.

Dryden regarded 'Nature as a Godly Ideal of Conduct', and poetry as an expression of the Ideal. Whereas Philip Sidney realized that the Ideal or Virtue was diminished when it must be expressed in social life, and at times there was no option to "infected wil", Dryden was very sensitive to the disorderly, unruly, unethical social world in which he lived. In his essay on Dryden, Bronowski devoted considerable discussion to Dryden's play "All for Love". In this play Dryden presents Antony as a man of godly features who falls from grace by allowing himself to be seduced by his love for Cleopatra. As well, Antony is taken in, or betrayed, by his brother-in-law Octavius, and he betrays his own admirers and supporters. Antony's conduct is a study in disorder and the failure to act in the right way results from lapses in ethical conduct. This is in contrast to Shakespeare's *Antony and Cleopatra*, where Shakespeare was rather more concerned with the character studies than ethical considerations.
Yet Nature, the root passion of the mind is expressed in poetry when Dryden wrote "To the Pious Memory of the Accomplisht Young Lady Mrs Anne Killigrew ..." his eulogy to the quality of the young lady's poetry:

*O Gracious God ... My Heav'ny Gift of Poesy.* Dryden questions:

- *O Gracious God! How far have we*
- *Prophan'd thy Heav'ny Gift of Poesy!*
- *Made prostitute and profligate the Muse,*
- *Debas'd to each obscene and impious use,*
- *Whose Harmony was first ordain'd Above,*
- *For Tongues of Angels and for Hymns of Love!*


The conflict between order, honesty, truth and disorder, is the theme in *The Hind and the Panther* a poem in which Dryden deals with the conflicts in religion and the State, and the power struggles within religions themselves. Bronowski makes the point that Dryden had an abhorrence of disorder in earthly conduct amongst men and women. Dryden was an astute and perceptive observer of political and social power manoeuvring in his day. This selection of lines from, *The Hind and the Panther* illustrates his sensitivity to disorder, which centres around Nature the root passion of the mind.

*No written laws can be so plain, so pure,*
*But wit may gloss and malice may obscure.*


There are many references in Dryden's work to "jarring Atomes" (Auden and Pearson, Vol III, p237), to "Atomes casually hurled together" and to "Blockheads and Time Servers" in government (Dryden, in Auden and Pearson, Vol III, p237).

Dryden returns to order with:

*For that which must direct the whole must be*
*Bound in one hand of faith and unity.*

It is interesting to see how the word Nature begins to have references to stability and instability and to everyday human affairs, moving away from the ethical principle of Nature as a stabilizing mental concept in the work of Sidney. The words God and Nature as socializing constructs will again be referred to in the
discussion of William Blake and the profound instability that resulted from the industrial revolution.

Again, there is a contrast between Dryden's desire for unity and order and his awareness of disorder in society, when he wrote these lines:

Great wits are sure to madness near all'd  
And thin Partitions do their bounds divide

from Absalom and Achitophel (Dryden, in Auden and Pearson, Vol III, p207).

Dryden calmed his agitation at disorderly aspects of life by his belief: "When rolling time is lost in round Eternity". By this Dryden means that the disorder of time rolling - that is, events in daily life - gives way to the perfection and orderliness of the concept of the eternal circle.

Bronowski's chapter on The Nature of Time in The Arrow of Time (Bronowski, 1964) is relevant here. He argues that inevitably over time, all events change from order to disorder. Dryden solved this degenerate state of affairs by characterizing rolling times evolving ultimately into the perfectly round Eternity.

Rolling Time lost in round Eternity is reminiscent of the presence of the erected wit in Sidney's values - the 'erected wit of virtue' and the 'infected wil of the senses'. Erected wit relates to virtue which is timeless and godly beyond everyday experience, that is 'round eternity', while the infected wil is related to the functioning of the senses, and subject to the variability of a person and his times, whether pursuing socially humane goals or self centred aggrandizement.

The same dilemmas are given expression in the philosophy of William Blake. He asserted that man's vision for self fulfilment was continually being thwarted by the mutilation or harm done to people by certain restrictive or exploitative elements of society. He believed that humans moved in a progression within themselves between innocence and experience.

2.4 William Wordsworth

When Bronowski comes to consider William Wordsworth, the next of the poets of significance in The Poet's Defence, the change in the meaning and use of the word Nature in poetry, indeed the purpose of poetry is dramatically changed from
the ethical considerations of conduct in Sidney and Dryden to unashamed pleasure in Wordsworth.

Bronowski regards William Wordsworth as the last in the line from Sir Philip Sidney and John Dryden, and at the same time, he is the first of the Romantic poets. William Wordsworth, together with William Blake, are powerful poets in the Romantic movement. Two words which most characterize Wordsworth are Nature and Pleasure. Nature is seen by this poet as a benevolent, all embracing experience - trees, earth, bushes, rocky caves, balmy summer evenings, seashore, ocean, sky, clouds, grass with rain, cold, gentle rivers, hard mountains, country people, are all intermingled as rustic life. It needs to be emphasised that Nature generates in human nature the joys, satisfactions, happy events, with fears, despairs, anxiety, and the sadness of everyday life. For Wordsworth, the life that gives nourishment and pleasure to humans, is the rustic life. Wordsworth regards the rustic life as giving authenticity to people. Wordsworth did not regard the rustic people as simple people. Their lives were worthwhile, and their basic language and lifestyles were free from the "din of towns and cities". (Wordsworth, Tintern Abbey, in Auden and Pearson, pp192-194). The style of rustic life makes it authentic.

Figure 2.3 A tinted drawing of William Wordsworth aged 36 (1806) by Henry Edridge.
The essential feature of Wordsworth's belief as a poet, and his theory of poetry as Bronowski presents it, is that "the poet is pleased with his own passion; this pleasure is the model of all Wordsworth's pleasure. And he finds and makes like passions in the goings-on of the universe". (Bronowski, 1939, p133). As Wordsworth himself said: "The poet thinks and feels in the spirit of human passions". (Wordsworth, in Bronowski, 1939, p134).

The root passion of man is pleasure, generated by receptivity to nature. The expression "root passion" links Wordsworth to Dryden and to Sidney. While the expression "root passion" means a basic or essential quality to the philosophy of that particular poet, yet very much the term moves away from Sidney and Dryden towards nature as it came to be understood in the 19th century. Wordsworth's "root passion" is much closer to the perception of Nature as we know it in the late 20th century, where the term is more inclined to have empirical or sensory experiences. Bronowski disapproves of the change because it means a move by the poets after Wordsworth further from virtuous ethical experiences of the Truth as portrayed by Sidney and Dryden. The schematic chart on p105 illustrates this move.

Dryden had the root passion of nature as an ethical principle, Sidney had "erected wit". Wordsworth unashamedly enjoyed the aspects of human life, earlier characterised as the "infected wil" of Sidney, and he was aware of the machinations of human life which so troubled Dryden.

Thinking back to Bronowski's Judaic upbringing with his "Old Testament" father, and the emphasis his father and Bronowski himself gave to ethical behaviour, I wonder whether this colours his seeming disapproval of Wordsworth's pleasures at the passions of life. Bronowski was a young man when he wrote The Poet's Defence, and although energetic, bubbly, and alive to his forthcoming meeting with the sculptor Rita Colin, was he not inclined to be too committed to being a Rationalist, or an intellectual who was uncomfortable with poets, like Wordsworth, whom he saw as self indulgent.

The strength of the value which Wordsworth placed on rustic life and its pleasure is well illustrated by these lines from his poem:
The Prelude (1798 - 1803)

Wisdom and Spirit of the universe!  
Thou Soul that art the eternity of thought,  
That givest to forms and images a breath  
And everlasting motion, not in vain  
By day or starlight thus from my first dawn  
Of childhood didst thou intertwine for me  
The passions that build up our human soul;  
Not with the mean and vulgar works of man,  
But with high objects, with enduring things -  
With life and nature - purifying thus  
The elements of feeling and of thought,  
And sanctifying, by such discipline,  
Both pain and fear, until we recognize  
A grandeur in the beatings of the heart ...


It is no surprise that Bronowski considered Wordsworth to have left the universal, absolute and direct experiences of "pure" Sidney and "socially cynical" Dryden. Wordsworth's lines from The Prelude have overtones which are recognised today by the humanistic psychologists like Abraham Maslow, and are part of the modern nature theology such as the God and the creative spirituality of writers like Mathew Fox. Wordsworth's philosophy is also related to the ecological concerns of the latter part of the 20th century.

The breadth of Wordsworth's awareness of city life included his disdain for the meanness and vulgarity of aspects of life in the city. In the lines "Residence in London" from the poem Prelude he saw before him:

Upon some showman's platform. What a shock  
For eyes and ears! What anarchy and din,  
Barbarian and infernal - a phantasma,  
Monstrous in color, motion, shape, sight, sound!  
Below, the open space, through every nook  
Of the wide area, twinkles, is alive  
With heads; the midway region and above,  
Is thronged with staring pictures and huge scrolls,  
Dumb proclamations of the Prodigies;  
With chattering monkeys dangling from their poles,  
And children whirling in their round-abouts;  
With those that stretch the neck and strain the eyes,  
And crack the voice in rivalry, the crowd,  
Inviting; with buffoons against buffoons  
Grimacing, writhing, screaming, - him who grinds
The hurdy-gurdy, at the fiddle weaves
Rattles the salt-box, thumps the kettle-drum,
And him who at the trumpet puffs his cheeks,
The silver-collared negro with his timbrel,
Equestrians, tumblers, women, girls, and boys,
Blue-breeched, pink-vested, with high towering plumes.


Wordsworth continued his description of the fair...

... as if the whole were one vast mill
Are vomiting, receiving on all sides,
Men, women, three-years' children, babes in arms.


And concluded his account of life in the city, with a broad perspective:

Oh, blank confusion! True epitome
Of what the mighty city is herself,
To thousands upon thousands of her sons,
Living amid the same perpetual whirl
Of trivial objects, melted and reduced
To one identity, by differences
That have no law, no meaning, and no end -
Oppression, under which even highest minds
Must labour, whence the strongest are not free.


Some might say that in the 1990's, the modern day carnival atmosphere of the football match, the Melbourne Cup Race, the cricket match, take the place "of the perpetual whirl of trivial objects". With this deeply perceptive description of how city life affects people, Wordsworth provides Bronowski with a contrast to Dryden's need for order and Sidney's value on godly virtue.

Reading the lines of Wordsworth about the carnival from the Residence in London with the description of the fair, reminds me in a curious way of the poem O Sweet Woods of Philip Sidney. Both poets are deeply involved in their subject. Sidney gives a loving account of the woods; Wordsworth gives a colourful account of the plays and acts of humans in a big city.

Both poets Sidney and Wordsworth are pleased with their subject matter. When Wordsworth writes of "Oh, blank confusion; True epitome of what the mighty city is herself", he is touches on a similar theme to the second part of O Sweet
Woods in which Sidney gives his perception of the disorderly life inherent in the power play of the Elizabethan Court. So that while Sidney and Wordsworth's poems are a construct of what they see, they also have much in common with each other: studies of human life.

Poets themselves are not immune from life inside themselves, or from the world outside. In his poem Resolution and Independence, Wordsworth said:

We poets in our youth begin in gladness;
But thereof come in the end despondency and madness


Here Wordsworth is in effect characterizing his epistemology. Bronowski takes the opportunity to point out again, how Wordsworth represents the decline from the ethical heights of Sidney, to the worldly experiences of the 19th century poet. Wordsworth's epistemology contrasts with that of Plato, the fifth century BC Greek poet and philosopher. Whereas Plato believed that we are born with all available knowledge, and the knowledge unfolds and expands human understanding in the course of living, Wordsworth believed that our sensitivity to experience and awareness decline as we age. He wrote about the decline from gladness to despondency in his significant work Intimations of Immortality.

Our birth is but a sleep and a forgetting:
The Soul that rises with us, our life's Star,
Hath had elsewhere its setting,
And cometh from afar:
Not in entire forgetfulness
And not in utter nakedness,
But trailing clouds of glory do we come
From God, who is our home:
Heaven lies about us in our infancy!
Shades of the prison-house begin to close
Upon the growing Boy,
But He beholds the light, and whence it flows,
He sees it in his joy;
The Youth, who daily farther from the east
Must travel still is Nature's Priest,
And by the vision splendid
Is on his way attended;
At length the Man perceives it die away,
And fade into the light of common day

From this poem when Wordsworth writes:

Shades of the prison-house begin to close  
Apon the growing Boy,

I can understand well that this idea of closing down so early in life would be rejected by Bronowski who in England as a schoolboy, and later as a student at Cambridge, discovered what he called "light" with which he characterized life in the Western World. It does seem that Bronowski's outlook for many reasons is incompatible with Wordsworth. Bronowski wanted life, and wanted his struggle with life, but his real blow and struggle was yet to come, when he visited Nagasaki in 1945.

It is confirmation of Wordsworth's perceptiveness on the progress of man through his life, that a modern day psychologist like Erik Erikson in setting out the eight stages of human development from infancy to maturity contrasted the option of generativity with despair in the older years of human life - "and fade into the light of common day" as Wordsworth has said.

Bronowski takes Wordsworth to task for the sentiments the poet expressed in his poem Lines Composed a Few Miles Above Tintern Abbey - On Revisiting the Banks of the Wye during a Tour. (Wordsworth, in Auden and Pearson, Vol IV, p192). Bronowski asserted that at this time in Wordsworth's life, when he wrote Tintern Abbey (1797), Wordsworth had declined or retreated as a genuine poet from responding to direct experience of nature into recollections of past experiences.

Certainly Bronowski is right to assert that Wordsworth retreated from direct experience of the river Wye, but the poem is a powerful organic, living account of Wordsworth's inner, private self. Read as a whole, Tintern Abbey is a moving experience because Wordsworth, then 28 years old, reveals himself as having to come to terms with the previously lived experience of the Wye five years earlier. This is now an enjoyable and, at times, a melancholy recall. But Bronowski is so dismissive of Wordsworth's failure to experience the Wye directly, that he, (Bronowski) could be said to be a brash young man, for the reasons I have given. Perhaps Bronowski is too eager to make his point that young men in science butt
their heads against the rocks of big scientific issues like the quantum physics of his time and earlier in the century while poets retreat.

I am inclined to think that Bronowski was being too simple and single minded in his assessment of Wordsworth here, because Bronowski's assertion that young scientists butt their heads against the rocks of big scientific issues, is probably too broad a generalization. Robert Reid's comment in Chapter 1 about the conservative scientific establishment in Britain, may well support my assessment of Bronowski here.

_Tintern Abbey_ deserves to be quoted in full, but it is too long to do that here. Instead the lines below are offered to show Wordsworth's pleasure, his resignation to his present self, and his appreciation of past rustic life.

_Five years past; five summers with the length_  
_Of five long winters! and again I hear_  
_These waters, rolling from their mountain-springs_  
_With a soft inland murmur. - Once again_  
_Do I behold these steep and lofty cliffs,_  
_That on a wild secluded scene impress_  
_Thoughts of more deep seclusion; and connect_  
_The landscape with the quiet of the sky. ..._

_Except, in lonely rooms, and 'mid the din_  
_Of towns and cities, have I owed to them_  
_In hours of weariness, sensations sweet, _  
_Felt in the blood, and felt along the heart;_  
_And passing even into my purer mind, _  
_With tranquil restoration - ..._

_How oft, in spirit, have I turned to thee,_  
_O sylvan Wye! thou wanderer thro' the woods,_  
_How often has my spirit turned to thee!_


Whatever Bronowski might assert about Wordsworth's expression of direct experience, these gentle contemplative lines show that Wordsworth was alive within himself, and suggest again to me that Bronowski was too excited about his life in England to appreciate the quiet respectfulness of a man like William Wordsworth.
Another poem to illustrate Wordsworth's awareness, this time of his colleagues, is *Great Men Have Been Among Us*.

Lest it be thought that Wordsworth had set aside the great traditions established by poets of earlier times, these lines are selected from his poem:

**Great Men Have Been Among Us.**

Great men have been among us; hands that penned  
And tongues that uttered wisdom - better none;  
The later Sidney, Marvel, Harrington,  
Young Vane, and others who called Milton friend.  
These moralists could act and comprehend:  
They knew how genuine glory was put on;


To round off this study of Wordsworth, nothing can be more appropriate than to quote again from *Intimations of Immortality*:

Though nothing can bring back the hour  
Of splendour in the grass  
Of glory in the flower;  
We will grieve not, rather find  
Strength in what remains behind;  
In the primal sympathy  
Which having been must ever be;  
In the soothing thoughts that spring  
Out of human suffering;  
In the faith that looks through death,  
In years that bring the philosophic mind.


Perhaps Worthsworth's significance in literature is not only the charm and genuine simplicity of his responses to rustic and city life, his contrast of one with the other, but ultimately his awareness of the "philosophic mind". This could be interpreted to mean that Wordsworth understood and wrote about the relationship between the mind, the thoughts of a person, and their bodily reactions, as in *Tintern Abbey*.

It is conceivable that Bronowski found this unethical in the sense that he has described his belief in the ethical purpose of poets, because Bronowski was
concerned to contribute his Judaic beliefs of help to humanity, outgoing towards humanity, as expressed in his Jewish Chronicle article. It is my perception of Bronowski, from that point of view, that led me to use the term ‘Intellectual Struggle’ in the title of Chapter 1.

Wordsworth did not struggle with his life or himself in the sense that Bronowski used that idea - Wordsworth struggled to maintain his personal integrity. That is more like modern twentieth century thought. Wordsworth and Bronowski had quite different temperaments. These thoughts of mine are speculations, and it confirms how much one misses the autobiography that Bronowski planned to write before he died.

2.5 Samuel Taylor Coleridge

Wordsworth's "philosophic mind" was badly shaken by Samuel Taylor Coleridge (1772 - 1834), whose belief and practice of poetry was expressed in his statement "the best part of human language, properly so called, is derived from a reflection on the acts of the mind itself". (Coleridge, in Bronowski, 1939, p175).

Because Bronowski spends much of his chapter on Coleridge, discussing that poet's philosophy, he gives relatively few examples of Coleridge's work. I have chosen three poems to illustrate Coleridge's belief that the "best part of human language properly so called, is derived from a reflection on acts of the mind itself", repeating this statement because it is such a departure from the other poets so far considered in The Poet's Defence.

The poem Kubla Khan is an example of Coleridge's belief that acts of the mind and human language, generated what he considered poetry. Bronowski found this quite unacceptable, since he saw it as word play quite divorced from the basic root passions of the genuine poets striving to express Truth.

In Xanadu did Kubla Khan
A stately pleasure-dome decree:
Where Alph the sacred river ran
Through caverns measureless to man
Down to a sunless sea.

So twice five miles of fertile ground
With walls and towers were girdled round:
And there were gardens bright with sinuous rills,
Where blossomed many an incense-bearing tree;
And here were forests ancient as the hills,
Enfolding sunny spots of greenery


This luxurious scene is disturbed by a huge eruption:

Huge fragments vaulted like rebounding hail, ...
And 'mid this tumult Kubla heard from far
Ancestral voices prophesying war

(Coleridge, in Auden and Pearson, Vol IV, p154).

and finally, Coleridge lapsed hedonistically into:

For he on honey-dew hath fed
And drunk the milk of paradise

(Coleridge, in Auden and Pearson, Vol IV, p155).

Although Kubla Khan was generated in a dream-like state induced "in consequence of a slight indisposition an anodyne had been prescribed, from the effect of which he fell asleep in his chair ..." (Coleridge, in Auden and Pearson, Vol IV, p152) the poem has the atmosphere of the "theatre of nature," (Bronowski, 1939, p156). The poem perhaps has the quality of a psychedelic experience, with an extravagant use of words, illustrating Coleridge's reflection "on the acts of the mind itself". It is an intellectual poem, or a rational poem infused with pleasurable thoughts. To this extent, Coleridge follows the pleasure principle set forth by Wordsworth, yet shows the departure from the wholesome rustic life which Wordsworth valued so highly as genuine life experience.
In a sense, Coleridge's poetry sets the pattern of the self-centred poets, who moved away from the concerns of the ethical integrity of human life set by Sidney and Dryden. As Coleridge said of poetry "it is an art of expressing, in words external nature and human thoughts and affections, both relatively to human affections by the production of as much immediate pleasure in parts as is compatible with the largest sum of pleasure in the whole ... A poem is that species of composition which is opposed to works of science, by proposing for its immediate object pleasure, not truth". (Coleridge, in Bronowski, 1939, p164). Coleridge was being a man of his time in equating "the works of science" with truth. This may well reflect the confidence of nineteenth century scientists who believed that the rationality and methods of their time would reveal the full truth of the natural world. It was early in the twentieth century that quantum mechanics upset that belief, especially through the statement of Heisenberg's Indeterminacy Principle and Bohr's Complementarity Principle, justifying Bronowski's belief that science gives near-truth not absolute knowledge.

Coleridge's belief in science as truth was the kind of comment that later aroused Bronowski and CP Snow to charge Coleridge's literary descendants at Cambridge in the 1930's with turning their backs on modern science and retreating into mere words of literature, because they were insensitive to or unaware of the profound
imaginative developments in quantum physics which illustrated that science was not the truth of the nineteenth century believers.

Bronowski begins his chapter on Coleridge in *The Poet's Defence* by stating that Wordsworth and Coleridge quarrelled over poetry because they were of two different tempers. They were temperamentally different, and the gulf is apparent in their views of Nature in human life. In contrast to Wordsworth who drank in and enjoyed the root passion of pleasure derived from nature, Coleridge quite simply says that "the natural scene is worthy only as it is filled by the life of Man" (Coleridge, in Bronowski, 1939, p166). For Coleridge, the imagination, an "I am" experience, accords a place for Nature. As Coleridge, through Bronowski, boldly asserts "man's worth is to be alive, and that all else gains worth only by partaking in his act of being alive". (Coleridge, in Bronowski, 1939, p168).

When Coleridge says that the natural scene is nothing only as it is filled by the life of man, he is probably unwittingly expressing a profound development to come - that what we as humans see is what is real to us and what we act on, and this could relate to Sir James Jeans' observation "The universe begins to look more like a great thought than a machine". (Wolf, 1981, p226).

Coleridge's narrative poem *The Rime of the Ancient Mariner* shows how his imagination is used to integrate experience. Through his use of the Wedding Guest, the mariner restores himself into the world by relating the penance he suffered for destroying the generous presence of the albatross. The mariner learns the hard lessons that:

*He prayeth best, who loveth best*
*All things great and small;*
*For the dear God who loveth us,*
*He made and loveth all*

(Coleridge, in Auden and Pearson, Vol IV, p151).

The last line "He made and loveth all" may well reflect a sense of unity with the natural world and bring Coleridge into the sentiments of the concern for the preservation of nature so characteristic of our own times in the late twentieth century. When the Mariner killed the albatross, there was not only penance, but a
break with the unity of a living connection between all nature. The current
corruptions about the destruction of forests around the world are examples of this
break. So, Coleridge's thinking, at times, ranges quite widely and his integration
of intellectual pleasure of the mind in poetry coupled with his imaginative
sensitivity to the natural world suggested by *The Rime of the Ancient Mariner*,
make Coleridge remarkably akin to some aspects of William Blake. Blake's poem
*The Divine Image* will illustrate this.

The complexity of Coleridge's beliefs in the relationship between the poet and
nature is his belief that 'we receive but what we give' expressed in the lines from
*Dejection: an Ode:*

... *O Lady! We receive but what we give,
And in our life alone does nature live*

(Coleridge, in Auden and Pearson, Vol IV, p156).

Although Bronowski leaves aside some aspects of Coleridge's poetry, he does
well to contrast Coleridge with Wordsworth in order to illustrate the difference
between the two poets. More and more the emphasis is on statements about the
psychology of human relationships in different ways moving from the elevated
ethical passions of Dryden and Sidney. Coleridge also expresses, in the line "we
receive but what we give" the rise of the independent individual, which was a
prime development out of the industrial revolution. Bronowski deals with
independence in the individual at length in his works on William Blake. The
schematic chart which accompanies this chapter gives some indication of how
poets like Coleridge had moved so far from Dryden and Sidney by the time the
nineteenth century arrived.

Nevertheless, Coleridge for all his elaborate extravagant play with words, and
intellectual detachment from Nature, was both within himself and towards his
friends, a sensitive man who showed depth of feeling in the poem *The Lime-Tree
Bower, My Prison*. This poem was generated when Coleridge, having invited his
friends to visit him, "met with an accident, which disabled him from walking
during the whole of their stay" (Auden and Pearson, Vol IV, p159). Coleridge
was especially distressed because he could not walk with "my gentle hearted
Charles" (Lamb) (Auden and Pearson, Vol IV, p162).

Well, they are gone, and here must I remain,
This lime-tree bower my prison! I have lost
Beauties and feelings, such as would have been
Most sweet to my remembrance even when age
Dimmed mine eyes to blindness! They, meanwhile,
Friends, whom I never more may meet again,
On springy heath, along the hill-top edge,
Wander in gladness ...


It takes a brave man to accept "my prison" from physical limitations and
Coleridge was able to compose himself with the lines:

Tis well to be bereft of promised good,
That we may lift the soul, and contemplate
With lively joy the joys we cannot share

(Coleridge in Auden and Pearson, Vol IV, p162).

Overall Bronowski does not bring out the potentialities of Coleridge. He tends to
focus on Coleridge as an intellectual who perceives Nature from the narrow
 confines of acts of the mind. Wittingly or not, Coleridge was a fore-runner of the
physics to come in the twentieth century where the perceiver or knower affects
what is known. The Rime seems to go beyond Christian penance to be concerned
with the organic unity in Nature and people, another concern of the twentieth
century.

2.6 Percy Bysshe Shelley

In The Poet's Defence Bronowski moved a contemporary of Wordsworth and
Coleridge, Percy Bysshe Shelley, (1792 - 1822), out of his time; placing him 250
years earlier into the Elizabethan era, to emphasise the contrast of his values with
those of Sir Philip Sidney. But for the purposes of following Bronowski's plan to
show the changes in the decline of poets in status, dignity and the quality of
absolute and direct experience - and time - Shelley will now be considered as one
of the eight poets in Bronowski's study.
Although Mary Shelley's perceptions of her husband Percy are included in Bronowski's discussion of AC Swinburne, (Bronowski is inclined to complicate his book by moving people in and out of chronology), it is appropriate to begin the discussion of Shelley with Mary's analysis. She wrote "Shelley shrunk instinctively from portraying human passion, with its mixture of good and evil, of disappointment and disquiet. Such opened again the wounds of his own heart; and he loved to shelter himself rather in the airiest flights of fancy, forgetting love and hate, and regret and lost hope, in such imaginations as borrowed their hues from sunrise or sunset from the yellow moonshine or the palely twilight". (Bronowski, 1939, p188).

When I came to read Shelley, especially in volume 4 of Auden and Pearson, I had to agree with Mary Shelley, that Percy Bysshe Shelley's Defence of Poetry was written in response to Thomas Love Peacock's views on The Four Ages of Poetry (Bronowski, 1966). In Bronowski's analysis of the action-reaction of Peacock and Shelley, it is clear what Bronowski meant when he said he presented his studies of the eight poets "as reasoned as geometry" (Bronowski, 1939, p8). Peacock, in the 19th century is not the Puritan, Stephen Gosson, whom Sir Philip Sidney had to face. Bronowski gives no information about Peacock as a person; he simply
presents Peacock's views of Society. In essence, Peacock says there is the lawless Iron Age, then the Age of Plundering and Marauding chiefs and kingdoms, then the Golden Age when society looks back with awe on the plundering kingdoms, and finally the Silver Age of Reason. Poetry is the appropriate way to write about the savages and the simple people of the Golden Age. The poet writes about the warriors of the past. But in the Age of Silver, clearly Peacock's own time in the early 19th century, there is the power of Reason, assembling, ordering, arranging knowledge in a rational way, leading to the quality admired by Peacock of "philosophic mental tranquillity" (Bronowski, 1939, p65).

This is the scientific habit of thought "from the materials of useful knowledge thus collected, appreciated, and arranged, forms new combinations that impress the stamp of their power and utility on the real business of life" (Bronowski, 1939, p65). Compared with Shelley (as characterized by his wife Mary), Peacock is a goal oriented, no-nonsense man living in the age of the fruits of the industrial revolution, where Man masters Nature. As Peacock says "It (poetry) cannot claim the slightest share in any one of the comforts and utilities of life of which we have witnessed so many and so rapid advances" (Bronowski, 1939, p67).

Shelley escapes the real world of human desires and disappointments and the world of the fruits of the technology of the industrial revolution such as the iron bedsteads and cotton dresses to which Bronowski refers in another place. Bronowski charges Shelley with escaping into Love, not the active love of a man and a woman, but into Love as a principle. Shelley's defence against Peacock's emphasis on the orderly, practicality, and rationality of the modern (19th century) age, is to acknowledge the significance of Reason. Even as Shelley escapes from Peacock's assertion that poets should deal with the past age of the warrior, he emphasizes the significance of Imagination, which gives pleasure. Here he is unlike Coleridge, who asserted that the poet should express pleasure as an experience of Life. For Bronowski, this emphasis demeans Shelley's status as a poet, who ought to be dealing with ethical values and issues, and makes him a social psychologist, not a poet, because pleasure is as measurable as the facts of natural science. Bronowski's claim that Shelley is more a social psychologist,
because pleasure in Love among humans is his aim, is a dubious claim. Social psychology had not developed in Shelley's time, and certainly "pleasure is measurable as the facts of natural science" was simply not true in Shelley's day, and may well be a dubious claim when Bronowski was writing in 1939. Natural science as an activity of measurement of natural events was far more advanced than social psychology as a discipline dealing with measurement of subtle human relationships like pleasure.

As Bronowski understands and explains Shelley, the key expression to generate pleasure is "love thy neighbour as thyself". The optimism which this formula implies is that evil will be dispelled or rendered ineffective. Shelley's wife believed that her husband avoided the hard facts of life with this formula.

Relevant to Mary Shelley's comments, the poem *Prometheus Unbound* illustrates Shelley's belief, and together with other of his poems share the optimism of 'all's right with the world'. In *Prometheus Unbound*, Prometheus creates Jupiter who personifies evil. Evil to Shelley signifies tyranny, and is a binding and limiting force over humans. As with Coleridge's *Ancient Mariner* so Prometheus, by love, secures release from personal limitations imposed by evil. When Prometheus pities the evil figure of Jupiter, the chains which bind Prometheus fall off and

... Men walked  
One with the other even as spirits do  
None fawned, none trampled; hate, disdain, or fear,  
Self-love, or self-contempt, on human brows  
No more inscribed  

(Shelley, in Bronowski, 1939, p79).

Shelley's theme that all's right with the world, or that all is well that ends well, an optimistic style of thinking at the expense of reality, is apparent in many of his poems. One example is the concluding line to the poem *Lines Written Among the Euganean Hills*:

*And the earth grows young again*  
(Shelley, in Auden and Pearson, Vol IV, p328).

Additional examples are from, first of all, *Prometheus Unbound*:

*Dizzy, lost, yet unbewailing!*  
then from *Ode to the West Wind*:

*The trumpet of a prophecy! O, Wind,*  
*If Winter comes, can Spring be far behind?*

(Shelley, in Auden and Pearson, Vol IV, p322).

from *The Cloud*:

*Like a child from the womb, like a ghost from the tomb,*  
*I arise and unbuild it again*


This theme is repeated in *Adonais* - an elegy on the death of John Keats. The poem begins:

*I weep for Adonais - he is dead!"

and ends after long florid lines, with:

"*The soul of Adonais, like a star,*  
*Beacons from the abode where the eternal are"*

(Shelley, in Auden and Pearson, Vol IV, p353)

And, from *The Triumph of Life*, the first line is:

"*Swift as a spirit hastening to his task*"

to the final line:

"*Then what is life? I cried* -

(Shelley, in Auden and Pearson, Vol IV, p373)

In Prometheus, Shelley rather naively believed that men being essentially good, only need to be rich, to be well, happy, fulfilled human beings. The responsibility and role of the poet is to show that "love thy neighbour" leads to the good society and human fulfilment. The poet does this by loving his neighbour, meaning that he identifies with the good, and recognises the evil in people, as Prometheus did with Jupiter. This style of thinking about the solution to social issues, may well be a reflection of Christian doctrine, as Coleridge's *Ancient Mariner* reflects the forgiving aspects associated with loving all creatures, even those as lowly as the sea-snakes. Shelley also believed that the science of his day gave the knowledge for furthering human well-being. Shelley's account of the role of Imagination in generating pleasure in people, and how maintaining pleasure leads to good social
behaviour in adults, is not unlike William McDougall's *Outline of Social Psychology* written by a medical practitioner in the early 20th century.

McDougall's book which I read as a text in undergraduate studies in Psychology II at Sydney University in 1948, seemed more a book of opinions, appropriate enough, but without empirical research, and not in the vein of what a modern day humanist psychologist like Maslow would like psychology to be as a naturalistic science.

So it is difficult to understand what Shelley had in mind when in his lifetime in the early nineteenth century, he said that the science of his day gave knowledge for furthering human well-being. It was not until 1879 when Wilhelm Wundt set up his laboratory for psychological research, was there any attempt to study human life in a systematic way free from the old associations of philosophical speculation. Even then, Wundt considered, not broad psychological issues, but a "Science of the mind ... with experimental enquiries into the determinance of thinking, feelings, remembering, etc ..." (Sarfaty, 1993, p20).

One of Bronowski's fundamental beliefs is that creating a good social order only provides the means for a just civil society. In his major work on the poetry of William Blake, *William Blake and the Age of Revolution* (1972) and in his shorter radio play *The Face of Violence* (1954), Bronowski presents one of his passionate beliefs. This is that revolutions are the means of providing the foundations for a good human life. It is always the responsibility of individuals to use the social conditions of the good society to cultivate their uniqueness as rational imaginative people capable of dissent, concerned to pursue truth as knowledge and not to believe that certainty is knowledge. The role of Clarissa in *The Face of Violence* is an example of personal responsibility for love and well being.

In pursuing his beliefs about revolutions as starting points, Bronowski gives considerable attention to the American, French, and Industrial revolutions, to show how social upheaval is the means and not the end of good living for individuals. Particularly in *William Blake and the Age of Revolution*, Bronowski is at great pains to illustrate how poetry and the prophetic books of Blake
demonstrate the "mutilation" done to people by revolutions. The work of William Blake relates to Sir Philip Sidney. They are both concerned with the pursuit of fundamental ethical values, beyond the superficiality of "love thy neighbour" proposed by Shelley.

Having this in mind, it is no cause for wonder that Bronowski is curt, at times almost dismissive, in his assessment of the remaining three poets in his work The Poet's Defence. The three poets are Algernon Charles Swinburne (1837 - 1909), AE Housman (1859 - 1936), and WB Yeats (1865 - 1939). Bronowski describes them as "mock idealists" (Bronowski, 1966, p13). Bronowski says, all three of these poets shirked the world of real human affairs. When I consider the poetry of WB Yeats I dispute Bronowski's assertion that he was a "mock idealist". In the Preface to the 1966 edition of The Poet's Defence, Bronowski reviewed the reception that his first book (1939 edition) received. He observed "the widow of WB Yeats" (Yeats died while the book was being printed) "was offended by what I said about the poet's sexual imagery in old age, and took legal advice to know whether it was libellous. Laurence was scathing about my estimate of his brother. By way of balance, Desmond McCarthy thought the essay on Yeats outstanding, and Edwin Muir thought the same of the essay on AE Housman". (Bronowski, 1966, pix-x).

Bronowski grouped together the three poets, Swinburne, and Yeats, who take the beliefs of Wordsworth and Coleridge from the 19th century up to the beginning of the Great War (1914 - 1918), where Bronowski's study ends.

![Figure 2.6 A photograph of Swinburne](image.png)
2.7 Algernon Charles Swinburne

Swinburne took the Nature of Wordsworth and the abstract thought of Nature of Coleridge, and produced poetry as a theatrical experience, using grand phrases like "cadences of thunder", to describe the effects of words in poetry. Swinburne also sought a "pure poetry which shall not think" (Bronowski, 1939, p209). Neither Swinburne nor Housman concerned themselves with the issues of the "infected wil" and "erected wit" of Sir Philip Sidney; there are no root passions of John Dryden's Ideal of Nature, nor visions and the thwarting of visions of humans, which so moved the poet William Blake. Nor is there any depth of exploration of human values as in Wordsworth.

Non of these high human passions and values is relevant to Swinburne. For him, "the two primary and essential qualities of poetry were imagination and harmony", (Bronowski, 1939, p200), and in the same vein "the object is not to examine what is good but what has pleased" (Bronowski, 1939, p201). These words of Swinburne, are evaluated by Bronowski as "flimsy" (Bronowski, 1939, p200). In his pursuit of Swinburne's interests, Bronowski's own writing becomes quite discursive, almost agitated. He was concerned because Swinburne's mistake is made again and again today, by criticasters (commentators) like IA Richards, a Cambridge lecturer and critic, and a powerful advocate of Coleridge's values. His influence at Cambridge on students of literature, during Bronowski's time there, was one of the reasons which prompted Bronowski to begin his study of The Poet's Defence. A E Housman was another of the "pure" critics who prompted Bronowski's determination to write The Poet's Defence. These observations are made in the 1966 edition of the book (Bronowski, 1966, pviii). Swinburne counts off the "properties" of a poem, and finds that they do not give the worth of a poem. The worth must lie in what is left, and Swinburne sees nothing left but "the mere progress and resonance of the words" (Bronowski, 1939, p204).

Bronowski acknowledges that, like Shelley, Swinburne had the themes of "hatred of tyranny, a challenging of death, a living in the golden age, sorrow at the classical sorrows" (Bronowski, 1939, p206). He relates these lines of Swinburne, to give substance to his view that Swinburne deals in a frenzy of images, and sounds round the vague life of a golden age:
Ye forces without form and viewless powers  
That have the key of all our years in hold  
The prophesy too late with tongues of gold,  
In a strange speech whose words are perished hours,  
I witnessed to you what good things ye give  
As ye to what evil while I live

(Swinburne, in Bronowski, 1939, p206).

Bronowski has surely made his point. There are more examples of Swinburne's play with words:

... With lisp of leaves and ripple of rain;"  
"Blossom by blossom the spring begins  
The full streams feed on flower of rushes  
Ripe grasses trammel a travelling foot,  
The faint fresh flame of the young year flushes  
From to leaf to flower and flower to fruit


and from the same poem *Atalanta in Calydon*, sexual imagery in these lines:

The ivy falls with the Bacchanal's hair  
Over her eyebrows hiding her eyes;  
The wild vine slipping down leaves bare  
Her bright breast shortening into sighs;  
The wild vine slips with the weight of its leaves,  
But the berried ivy catches and cleaves  
To the limbs that glitter, the feet that scare  
The wolf that follows, the fawn that flies

(Swinburne, in Auden and Pearson, Vol V, p439).

In *A Leave-Taking* there is strong imagery about a woman's rejection of a man:

... Let us go hence, go hence; she will not see.  
Sing all once more together: surely she,  
She too, remembering days and words that were,  
Will turn a little toward us, sighing; but we,  
We are hence, we are gone, as though we had not been there.  
Nay, and though all men seeing had pity on me,  
She would not see.

(Swinburne, in Auden and Pearson, Vol V, p 441).
And a similar bitterness from *Hymn to Proserpine*:

... *Draining a little life from the barren breasts of love*

(Swinburne, in Auden and Pearson, Vol V, p442).

The threat in the line:

*White-eyed and poisonous-finned, shark-toothed and serpentine-curl*ed

(Swinburne, in Auden and Pearson, Vol V, p444).

And these words on Death:

*For the glass of the years is brittle wherein we gaze for a span;*
*A little soul for a little bears up this corpse which is man*

(Swinburne, in Auden and Pearson, Vol V, p447).

From another poem *A Dialogue*:

*Earth, sea and sky as rain all vapour shed,*  
*Shall vanish; all the shows of them shall flee:*  
*Then shall we know full surely quick or dead,*  
*Death, if thou be.*


Finally some word-play again, in a line from *A Ballad of Francois Villon*:

*Villon, our sad bad glad mad brother's name!*

(Swinburne, in Auden and Pearson, Vol V, p464).

Bronowski puts Swinburne in his place, both as to Swinburne's failure to put matter into his work, but also as a pointer to Housman. Bronowski writes "We must read him not for himself but for something else. We must read him because he is the sum of the nineteenth century. And the nineteenth century still writes our criticism" (Bronowski, 1939, p208). Damned with faint praise!

### 2.8 Alfred Edward Housman

In his study of AE Housman (1859 - 1936), who followed Swinburne, Bronowski said: "Both ask the same things of poetry, that it should move them by its sounds, and that it should move them in the senses. Both (Swinburne and Housman) "stand against any theory which seeks to make actual that very longing for life which fills their poems with dreams. For both have the longing of scholars for the
past, its books and its names. Both seek a 'pure' poetry which shall not think" (Bronowski, 1939, p219).

It is no wonder that Bronowski proclaimed the decline in significance in poetry as universal, absolute and direct experience. When he was at Cambridge he was markedly aware of the contrast between the stay-apart-from-the-real-life-attitude current in the literary circles, and the scientists and the students of science where they were all personally involved in their work: "They talked vigorously about scientific work, their own and that of others, and past as well as present; they even talked about the philosophy of science, which was struggling with the daring ideas of relativity and quantum physics. What they had to say was always personal and direct, the talk of active men who worked in the same vein as their heroes and butted their heads against the same rocks" (Bronowski, 1966, pvii).

As Bronowski developed his thinking on Housman's work, it became clear why Housman's brother Laurence took offence. What Bronowski did was to show that AE Housman trivialized the great ethical values of honour, courage, bravery, and self respect and therefore denigrated himself. Bronowski showed how Housman operated by hopelessly trying to hold together two disparate beliefs. One belief is in honour, courage and bravery - and the other the ultimate power of death which defeats the living values of honour, courage, and bravery.

"Poetry is not the thing said, but the way of saying it" (Bronowski, 1939, p210). Housman's essential idea is that:

"Poetry seems to me more physical than intellectual ... experience has taught me when I am shaving of a morning to keep watch over my thoughts, because if a line of poetry strays into my memory, my skin bristles so the razor ceases to act. This particular symptom is accompanied by a shiver down the spine; there is another which consists in a constriction of the throat and a precipitation of water to the eyes." (Bronowski, 1939, p213). That is not Dr Housman medical practitioner or physiologist writing; it is from Housman's essay The Name and Nature of Poetry (Bronowski, 1939, p213).
For Housman, poetry is sadness which brings "precipitation of water to the eyes". Bronowski characterized Housman's poetry as a ploy to extract from his readers sorrow for Housman's pitiable state! Gone is the power of Sir Philip Sidney's godly Virtue, John Dryden's root passion of Nature, and William Wordsworth's passionate depth of pleasure in Nature.

Bronowski analysed several stanzas of the poem *A Shropshire Lad* to demonstrate how Housman's most subtle tool was that of sadness: to make the reader pity him for a weakness which the reader was also asked to despise, and which Housman himself despised. However, for the present purpose there are two succinct stanzas from poems, which Bronowski used to illustrate two sets of feelings, the first one about love, friendship, honour, bravery; and the second that these feelings are as pointless as death. Firstly the stanzas which deal with the worthy side; bravery and the willingness to face death:

\[
\begin{align*}
\text{So here are things to think on} \\
\text{That ought to make me brave,} \\
\text{As I strap on for fighting} \\
\text{My sword that will not save.}
\end{align*}
\]

The other feelings fear death which seem to Housman to over-run every feeling

\[
\begin{align*}
\text{Lovers lying two and two} \\
\text{Ask not whom they sleep beside,} \\
\text{And the bridegroom all night through} \\
\text{Never turns him to the bride}
\end{align*}
\]

(Housman, in Bronowski, 1939, p221).

These last four lines about lovers lying side by side are so passionless that they illustrate the power of death as the potent factor in Housman's work. Housman takes the living forces and values of courage, honour, bravery and love, and deprives them of life. In other words, the presence of death is characteristic of Housman's poems. Bronowski's comment "that Housman himself did not respect his own feelings" is telling. Surely there cannot be a greater contrast in the deterioration of the universal, absolute, and direct perceptions of the great poets than to consider Housman's deliberate perception of death and to contrast it with the life existing in Sir Philip Sidney's Virtue. Perhaps the expression of 'water to the eyes' as a scientific term is another reflection of the influence of the
Newtonian worldview which contributed to the rise of science and in Bronowski's view the decline in dignity and status of the poet. I find myself in complete agreement with Bronowski's assessment of the failure of Swinburne and Housman, especially the latter, to generate poetry as an expression of universal, absolute, and direct experience.

Bronowski concluded his appraisal of Housman and Swinburne with the cryptic comment "... the ratio of words to thought in them is ... high" (Bronowski, 1939, p228). This is Bronowski the mathematician speaking!

2.9 William Butler Yeats

Before starting an account of Bronowski's responses to William Butler Yeats, I present two short poems of Yeats which have deeply moved me. The title of the first is He Wishes for the Cloths of Heaven:

Had I the Heavens' embroidered cloths,
Enwrought with golden and silver light,
The blue and the dim and the dark cloths
Of night and light and the half-light,
I would spread the cloths under your feet:
But I, being poor, have only my dreams;
I have spread my dreams under your feet;
Tread softly because you tread on my dreams.

(Yeats, in Duane, 1996, p35).

and the second poem is The Mermaid:

A mermaid found a swimming lad,
Picked him for her own,
Pressed her body to his body,
Laughed; and plunging down
Forgot in cruel happiness
That even lovers drown.

(Yeats, in Duane, 1996, p75).

There could be no greater contrast between Housman and the works of the Irishman, William Butler Yeats (1865 - 1939), the eighth and final poet in The Poet's Defence. During his talks Voyage around a Twentieth Century Skull, for the BBC, recorded as far as I can ascertain in 1974, Bronowski recalled
Cambridge in 1931 or 1932, attending a ceremony at which the scientist Albert Einstein and William Butler Yeats, the poet, stood side by side to be presented with Honorary Doctorates. Bronowski remembered Yeats as a "noble looking man".

Bronowski's treatment, "as reasoned as geometry" is perhaps too reasoned and austere for the vivid imagery of Yeats, and his sensitive responses to life. However, Bronowski did recognize that Yeats "made his fame with a soft and frenzied verse. He has kept it with a harsh and thoughtful almost a didactic verse" (Bronowski, 1939, p229). I think Bronowski refers to poems about Ireland's political civil wars and wars with England. Yeats himself said of his verse: "It is only ancient symbols, by symbols that have numberless meanings beside the one or two the writer lays an emphasis upon, or the half-score he knows of, that any highly subjective art can escape from the barrenness and shallowness of a too conscious arrangement into the abundance and depth of nature". (Bronowski, 1939, p243). Yeats is being self effacing, but pointing his poetry towards universal, absolute, and direct experience.

Even so, this awareness of Yeats is relevant to Bronowski's belief about the creative imagination and the origins and development of knowledge in humans, in the communality of the natural sciences and the humanities. Bronowski held that language is a basic 'instrument of the human intellect'; and language is used with great sensitivity in the poetry of Yeats.

It is not surprising that, although the work of Yeats relates back to Coleridge and Swinburne, and earlier still to Sir Philip Sidney, Yeats is considered quite distinctive, even unique in Bronowski's studies in The Poet's Defence.

Broadly, Bronowski divided Yeats' evolution into three areas. In the beginning, Yeats' central value was in purposeful living, where "purpose gives order" to an aimless living and lifts it above living (Bronowski, 1939, p230). In Coleridge's Ancient Mariner, the mariner's love for the lowly sea-snakes lifts him from penance to love. In Shelley's work Prometheus Unbound, the acceptance of love of his own creation, the evil Jupiter, frees Prometheus to love. Whether these are
Christian loves, or not, is immaterial. They are instances of universal human experiences.

For Yeats, purpose is worthy in itself. Bronowski pointed out that when the Countess Cathleen, in the poem *The Countess Cathleen*, "hears that her starving people are selling their souls for bread, in order to save them she sells her own soul and feeds them with the price" (Bronowski, 1939, p230). But, because her action was purposeful she wins grace for herself, and her bartered soul lifts to heaven. (Bronowski, 1939, p231). As Yeats' writes:

\[
\text{She, pity crazed, had given her soul away} \\
\text{But masterful Heaven had intervened to save it}
\]

(Yeats, 1996, p59).

The power of these lines recalls the beliefs of Viktor Frankl, psycho-analyst, who as a young man survived the Nazi concentration camps by finding meaning in helping others to survive. Frankl, who died in 1997, aged 92 years, wrote extensively on the topic of meaning and purpose - "Only to the extent to which man fulfils a meaning out there in the world, does he fulfil himself" (Frankl, 1972, p99).

Yeats couples great living and imaginative art with purpose, and like Sir Philip Sidney "Yeats' purpose is an ideal of poetry like Sidney's Virtue which can sometimes throw its light over living" (Bronowski, 1939, p231). Yeats at this time thought and wrote with a clear cause-effect purpose.

Then Yeats moved on and developed a sense of purpose through relating poets and women as expressions of Beauty. This sense of purpose is expressed in the lines:

\[
\text{To be born woman is to know} \\
\text{Although they do not talk of it at school -} \\
\text{That we must labour to be beautiful}
\]

(Yeats, in Bronowski, 1939, p232).

Yeats then began to find poetry painful, and he wrote about these pains as the conflict between image and sense. When social and political wars and strife in
Ireland made him grow bitter and lose belief in himself; there came a decline in his sense of purpose as giving meaning to life. However Yeats lived a varied and meaningful life in many ways: he founded the Irish Literary Society in Dublin; his collaboration with Lady Anne Gregory resulted in the founding of the Abbey Theatre in Dublin; he was awarded the Nobel Prize for Literature in 1923. Even so, he suffered the disillusionment of his unrequited love for Maud Gonne, a "beautiful determined young woman ... deeply committed to Irish Nationalism and ... (a) formidable campaigner for social justice" (Duane, p 9). Yeats felt deeply the loss of his youth as he aged.

*An Irish Airman Foresees his Death* is a powerful account of the waste and futility of war:

```
I know that I shall meet my fate
Somewhere among the clouds above;
Those that I fight I do not hate,
Those that I guard I do not love;
My country is Kiltartan Cross,
My countrymen Kiltartans poor,
No likely end could bring them loss
Or leave them happier than before.
Nor law, nor duty bade me fight,
Not public men nor cheering crowds,
A lonely impulse of delight
Drove to this tumult in the clouds;
I balanced all, brought all to mind,
The years to come seemed waste of breath,
A waste of breath the years behind,
In balance with this life, this death.
```

(Yeats, 1996, p27).

How different from the optimism of the *Countess Cathleen*. Yeats' anti-war poems must surely have found a chord in Bronowski, not only because of his personal distress with the Nazi regime and the European conflict, but also because of his earlier strong feelings about the Spanish Civil War.

Expressing a similar sentiment to *An Irish Airman Foresees his Death*, Yeats wrote *Easter 1916*, a poem of considerable length, about the political strife suffered by Ireland and its' people.
With deep pity and compassion he conveyed his distress about the senseless cost to his country and his beliefs. He had made a study of Celtic culture and he was deeply aware of its significance. The last section of the poem is:

Too long a sacrifice
Can make a stone of the heart.
O when may it suffice?
That in Heaven's part, our part
To murmur name upon name,
And a mother names her child
When sleep at last has come
On limbs that had run wild
What is it but nightfall?
No, no not night, but death;
Was it needless death after all?
For England may keep faith
For all that is done and said.
We know their dream; enough
To know they dreamed and are dead;
And what if excess of love

Bewildered them till they died?

I write it out in a verse -
MacDonagh and MacBride
And Connolly and Pearse
Now and in time to be,
What ever green is worn
Are changed, changed utterly;
A terrible beauty is born

(Yeats, 1996, pp29 - 30).

Another reference to Ireland's history is the poem *Come Gather Round the Parnellites:*

Come gather round me, Parnellites,
And praise our chosen man;
Stand upright on your legs awhile,
Stand upright while you can,
For soon we lie where he is laid,
And he is underground;
Come fill up all those glasses
And pass the bottle round.

And here's a cogent reason,
And I have many more,
He fought the might of England
And saved the Irish poor,
Whatever good a farmer's got
He brought it all to pass:
And here's another reason,
That Parnell loved a lass.

(Yeats, in Duane, 1996, p91).

So Yeats' moved a long way from the positive sense of purpose of Countess Cathleen. In the Foreword to The Poet's Defence Bronowski wrote "Poetry does not move us to be just or unjust. It moves us to thoughts in whose light justice and injustice are seen in fearful sharpness of outline" (Bronowski, 1939, p16).

Such poems as Easter 1916 moved Bronowski to characterize Yeats "as a poet great enough to stand against poetry"; certainly against the emptiness of Swinburne and Housman. I believe, as did Bronowski, that the poems Easter 1916 and An Irish Airman speak for all humans who have suffered disrupted lives in their countries of origin. Bronowski's family personally suffered this disruption when they were obliged to leave Germany and migrate to England in 1920. Easter 1916 and the Irish Airman speak for the universal and absolute and direct experience of great poetry.

Figure 2.7 A cover reproduction of Yeats from a painting by Augustus John.
In *Prologue to Responsibilities*, Yeats asks a pardon of his forefathers:

... *Old Butlers ... that leaped overboard*
*After a ragged hat in Biscayne Bay ...*
*Pardon that for a barren passion's sake*
*Although I have come close on forty-nine*
*I have no child, I have nothing but a book,*
*Nothing but that to prove your blood and mine*


Here also is Yeats' sense of Ireland's history, and his own familial part in the history, succinctly summed up in the expression *Old Butlers*. In these lines, too, Yeats communicates a sense of failure or perhaps that he fell short of his place in Irish society. Bronowski does not concern himself with Yeats' feeling for Irish history, and to that extent does not present sufficient understanding of the poet.

Yeats involvement with mysticism and Irish mythology came about quite early in his life, and as he became an older man, disillusioned that he had not found his place in the upper ranks of Irish society, and became aware of death, he uses mystical imagery to compensate for these felt limitations. The poems *Sailing to Byzantium* composed during 1928, nine years before his death, give an appreciation of this last phase of his life.

**Sailing to Byzantium**

I

*That is no country for older men. The young*
*In one another's arms, birds in the trees,*
-* Those dying generations - at their song,*
*The salmon-falls, the mackerel-crowded seas,*
*Fish, flesh, or fowl, commend all summer long*
*Whatever is begotten, born, and dies,*
*Catched in that sensual music all neglect*
*Monuments of unaging intellect.*

II

*An aged man is but a paltry thing,*
*A tattered coat upon a stick, unless*
*Soul clap its hands and sing, and louder sing*
*For every tatter in its mortal dress,*

100
Nor is there singing school but studying
Monuments of its own magnificence;
And therefore I have sailed the seas and come
To the Holy city of Byzantium.

(Yeats, 1996, p35).

This is powerful insight reaching into the heart of every older human being. In this way Yeats is communicating universal, experience; and it an aspect of his work that goes back to Sir Philip Sidney's integrity about human relationships.

Still in the same poem *Sailing to Byzantium*, Yeats cries:

III

... Consume my heart away; sick with desire
And fastened to a dying animal
It knows not what it is; and gather me’”
Into the artifice of eternity.


Bronowski points out that Byzantium is an artifice to indicate the direction of Yeats' escape from his body and its loss of value to him:

*Once out of nature I shall never take*
*My bodily form from any natural thing,*
*But such a form as Grecian goldsmiths make*
*Of hammered gold and gold enamelling.*

(Yeats, 1996, p36).

Here Yeats is still regarding the mystic life as the life of the mind, the "unageing intellect". With a second *Byzantine* poem Yeats moved to his third evolutionary change, where he regards the mystic life as a sexual life:

*Crossed fingers there in pleasure can*
*Exceed the nuptial bed of man;*
*A nuptial bed exceed all that*
*Boys at puberty have thought*

(Yeats, in Bronowski, 1939, p246).
The Ideal of purpose has become the Ideal of love of woman, so that Yeats writes:

_I pray for fashions - for fashions' word is out_  
_And prayer comes round again -_  
_That I may seem, though I die old,_  
_A foolish, passionate man_  

(Yeats, in Bronowski, 1939, p252).

Bronowski, although at that time a young man, ably summarizes Yeats' work and places it conceptually in the nineteenth century. When Yeats characterizes himself as "a foolish passionate man", Bronowski places the senses at the core of poetry. In effect the world of empirical knowledge derived from the senses, a nineteenth century belief, has been moved by Yeats from the natural world into mysticism, and Yeats sees the work of poetry in the senses. Yeats is a complex personality with his evolutionary changes. He has moved right away from his original position in _The Countess Cathleen_ where grace is purpose, to his final position of sexual mysticism. In this way, "Yeats stands against the line of poets whose ideal was poetry" (Bronowski, 1939, p252). Thus Bronowski conceptualized Yeats' as so distinctive and so different from the ethical values involved in Virtue when he began his study with Sir Philip Sidney.

To conclude the account of Yeats, which it must be said covers a relatively small part of his oeuvre, there is in this remarkable poem _The Crazed Moon_ a combination of Nature, Imagination, and human involvement.

_Crazed through much child-bearing_  
_The moon is staggering in the sky;_  
_Moon-struck by the despairing_  
_Glances of her wandering eye_  
_We grope, and grope in vain,_  

_For children born of her pain._  
_Children dazed or dead!_  
_When she in all her virginal pride_  
_First trod on the mountain's head_  
_What stir ran through the countryside_  
_Where every foot obeyed her glance!_  
_What manhood led the dance!_  

_Fly-catches of the moon,
Our hands are blenched, our fingers seem
But slender needles of bone;
Blenched by that malicious dream
They are spread wide that each
May rend what comes in reach.

(Yeats, in Duane, 1996, p87).

For all his own youth when writing about Yeats - Bronowski was 31 years of age - he did well when he says: "Yeats is a poet great enough to stand against poetry", as represented by the previous poets in The Poet's Defence. (Bronowski, 1939, p25).

The Poet's Defence was not an anthology of poetry, but a study allowing poets themselves to explain their poetry, and to illustrate Bronowski's belief that poetry had declined as an ethical force over the centuries since Sir Philip Sidney. Bronowski was upset by the literary circles who failed to recognize that poets rose above everyday experience to present studies into human affairs. He wrote in the preface to the 1966 edition "nevertheless, as I read what the critics wrote, I became aware that they had one thing in common: One and all, they were quite unmoved by my argument. Those who believed as I did, that poetry presents a universal truth, went on believing it, certainly after they read The Poet's Defence. And those who believed, as I did not, that poetry is merely another social utterance, went on believing it, respectfully, but firmly, after they closed the book. So far as I could learn, nothing that I had written had changed any reader's mind.

I was naturally chagrined by this immobility and I felt that I ought to be able to do better. There must be a more persuasive and concrete way to show the independence of poetry in the face of social change" (Bronowski, 1966, px).

The social change referred to by Bronowski was the era of the Industrial Revolution. He planned to compare "the last great poet before that, Alexander Pope, with the first great poet after it, William Blake" (Bronowski, 1966, pp x - xi). Bronowski's wartime research duties and "the hardships of printing and the uncertainties of writing in wartime ... persuaded me to get on with saying what I had to say about the vision of William Blake ... so I wrote an unexpected book
about Blake which (it turned out) gave a new direction to Blake criticism" (Bronowski, 1966, pxi).

Indeed, as it turned out, Bronowski was being modest. His studies of Blake, published in the 1954 wartime Pelican edition: *William Blake. A Man without a Mask*, and the later 1972 revised and enhanced version: *William Blake and the Age of Revolution*, has indeed given more than a new direction and a depth of understanding of William Blake, to set against the view of Blake by his contemporaries who thought him both mad and erratic and dismissed him as a man of little consequence.

The significance of Bronowski's studies of Blake, both in understanding the man and the revolution of his time, has relevance to our own twentieth century. This will become apparent in the next chapter.
### An Adaptation of the Plan of Bronowski's Study of the Eight Poets of The Poet's Defence

<table>
<thead>
<tr>
<th>Period</th>
<th>Values</th>
<th>Key Poets</th>
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| The Elizabethan Age of the Sixteenth Century | Ethical root passions giving universal absolute direct (UAD) knowledge: heroic quality of poetry. | **SIR PHILIP SIDNEY:** *Virtue*, God gives Ideal of ethical conduct occasionally flowing over into social moments.  
JOHN DRYDEN: Ideal of *Nature* as root passion of the mind, valuing order, abhorring disorder; “atoms casually hurled together.” |
| The Nineteenth Century             | Poetry as social, scientific, pleasure, imagery, self gratifying.       | **WILLIAM WORDSWORTH:** *Nature* as pleasure, experience in *Rustic Life*, providing “earthy”, trustworthy life, as against “din of towns and cities”.  
SAMUEL TAYLOR COLERIDGE: In opposition to Wordsworth. Poetry is the reflection of the mind’s view of works and the pleasure is the words – *Kubla Khan*, and Nature can reflect human intellectual activity.  
IA Richards of Cambridge, Coleridge’s pupil, aroused Bronowski to write *The Poet’s Defence* |
| Poetry as pleasure for social good has declined in significance from the values of Sidney to Wordsworth | Poetry as social, scientific, pleasure, imagery, self gratifying.       | **PB SHELLEY:** Science to be used to “Love thy Neighbour” to produce a “good” society to bring out the best in everybody. *pleasure in loving thy neighbour* and a good society is considered by Bronowski as measurable science, not UAD poetry. |
| The Nineteenth into the Twentieth Century to the Beginning of World War I | Poetry as social, scientific, pleasure, imagery, self gratifying.       | **AC SWINBURNE, AE HOUSMAN, WB YEATS:**  
These poets follow the manner of Wordsworth, but Bronowski in discussion of their use of poetry says they regard poetry as a vehicle for words - Swinburne's "Pure poetry", Housman's sadness and death over honour, courage and bravery. Yeats is of special significance - the most "unpoetic" of poets, Yeats uses his imagery over three evolutionary stages - poetry is purpose, then related to women, then a decline into sexual imagery associated with old age. |
3.1 Bronowski's Passion for William Blake.

Bronowski's pioneering studies of William Blake began with his wartime work *William Blake, 1752-1827 A Man Without a Mask* in 1942. How did Bronowski find the time, the energy, and generate the enthusiasm, while engaged in his secret wartime researches, to write such a powerful study of William Blake. For the purposes of this chapter, the second version published in 1944, and then issued in 1958 by the then new Pelican Books, will be used. The work covers Blake the person, his poetry, and his prophetic works, and particularly Blake's philosophy of being a whole adult. Bronowski's study also penetrates deeply into the history of Blake's life which covered three revolutions, the politics of the Whigs and Tories, and the power of the machine and the machine owners and inventors as they affected the lives of the ordinary men, women, and children in England.

When I concluded my writing of this chapter, I came back to the beginning and wrote the title *From Peterloo to Belsen*, out of regard for Bronowski, who lived during the time of the Nazi destruction and such death camps as Belsen; and out of regard for Blake who recorded the government troops' massacre of rioters at Manchester, the event called Peterloo.

In his later extended and revised study, the 1972 edition *William Blake and the Age of Revolution*, Bronowski himself explained "I have come to William Blake as the subject of my study because his work unites the timeless with the timely, the sense of destiny with the sense of the present. Like every great poet, he had the ear which caught the whisper of *The Everlasting Gospel* (proposed by the mystical anarchist dissenters with a Puritan tradition back to Oliver Cromwell's time) "with the everyday passions around him. It is the belief of great poets, that the condition of man expresses eternally the same themes of love, of truth, of justice and dignity" (Bronowski, 1972, p14).

When Bronowski links Blake's dedication to *The Everlasting Gospel*, with its values of love for humans through the gentle lamb of Jesus Christ, and the
values of truth and justice, Bronowski is again directing the poetical experience as universal, absolute, and direct. In this way, he is able to link his study of *The Poet’s Defence* with his work on William Blake.

Blake’s version of *The Everlasting Gospel* is a long poem characterized by vivid imagery depicting the traditional conflicts of God, Heaven, Jesus, Satan, the crucifixion and the like. But there is one Moral Virtue which distinguishes Blake’s *Everlasting Gospel*. Blake says "There is not one Moral Virtue that Jesus Inculcated but Plato and Cicero did Inculcate before him, what then did Christ Inculcate? Forgiveness of Sins. This alone is the Gospel and this is the Life of Immortality brought to light by Jesus ... "(Blake, in Bronowski, 1958, p73).

Bronowski’s introduction to Blake’s presence involving the themes of love, truth, and justice, expresses the same passions, beliefs and values, which he developed in *The Poet’s Defence* (Bronowski, 1939), and is as intense, but also more complex and complicated because of the complexity of personality and visual perceptions of Blake himself. As well, the Age of Revolution, or rather the Age of Revolutions - American, French, and Industrial - were all immensely complex and far reaching in their political, social and technical effects.

Bronowski said of the era of Blake: "Yet to the generation which lived through the age of Napoleon and William Pitt," (Prime Minister of England) "and Peterloo"(so called for the massacres of rioters at St Peter's Fields at Manchester, and the rise of the Luddites in 1819) "and the Six Acts", (repressive government measures) "the human condition was not an abstract play of ideals; it was experienced in famine and oppression, in poverty and neglect. This is why his age speaks so insistently to ours, for we are also, a generation of Belsen, and Sharpeville and Stalin's corrupt tyranny, have learnt that man's ideals of his own humanity have still to be fought for in every age" (Bronowski, 1972, p14).

Bronowski’s belief that man's "own humanity has still to be fought for in every age" is another of his arrows (using the imagery from Blake which headed
chapter two), in this case going straight to the heart of Blake's philosophy of self fulfilment. Another arrow is Bronowski's view, as with Blake, that society is a means, not an end to good living. This parallel of views from Blake and from Bronowski is developed below.

The energy and dynamics and endurance of Blake as a man, regarded as merely irrelevant and tiresome in his relations with people in his own day, but now thought as the first of the great Romantic poets, does seem unusual, when his personal history is considered. He was born in 1757, in Soho, the second son of a hosier, apprenticed as an engraver, and despite a huge output of poetry, engravings, books, and paintings, and at one time owning his own shop, and receiving commissions for his work, he remained undistinguished by worldly standards of position, and power in the everyday sense, and with no great money income. He was absorbed in his own visions. It is said that as a little boy William Blake saw a London tree swarming with angels. Only his mother's intercession prevented a thrashing from his father (Wordsworth Poetry Library, 1994, pv). As he grew, his visionary ideas expanded and infused all his work. He was constantly changing his imagery to suit the symbolism of his religious conceptions, and his portrayal of the industrial revolution.

Blake was characterized by Bronowski as "odd, unbending, wayward, and self absorbed" (Bronowski, 1972, p10), to outward appearances, but as well he was "full of lively interest, was playful and quick witted and witty ... " (Bronowski, 1972, p11). Some of his early "poetical sketches" show the playful happy young man. A page from Blake's notebook, including a self-portrait, is provided.
Closer examination of his work shows Blake was not mad but a sensitive dissenter in political, social and industrial issues, able to identify the plight of ordinary men, women and children. He went further to understand the needs and values of all humans of all times, in the eternal struggle with the thwarting of one's visions, to go on believing that the innocence of the child is the essential ingredient of the whole adult. This is considered in detail below.

These large scale concepts may seem showy and without empirical substance, but Bronowski's study of Blake shows the poet to be a uniquely sensitive man with insights into himself and to humans generally, that are akin to the best thinkers in science and the humanities.

From the science scene, an example of the sheer joy is that experienced by Otto Frisch when he told "Bohr of his (Frisch's) interpretation of the splitting of the
atom U - 92 and Bohr's marvellous enthusiasm ... "but this is wonderful, this is just as it must be" (Sarfaty, 1993, p141). Here the two men experience the unique, absolute, direct reactions, which Bronowski attributes to the poets.

Another episode of joy, was after an evening in the company of Niels Bohr and his family, he (Frisch) "cycled home through the streets of Copenhagen, fragrant with lilac or wet with rain, I felt intoxicated with the heady spirit of Platonic dialogue" (Sarfaty, 1993, p149).

The amazement of Frisch and his aunt Lise Meitner when in conversation they became aware of the idea of atomic fission (Sarfaty, 1993, p124), taken together with examples of self actualizing persons from the work of psychologist AH Maslow interconnect with Blake's sensitivities. The references to Frisch, Bohr, and Meitner, are given as examples of the joy of discovery which scientists are capable of at their best moments of awareness of themselves as distinctive persons. I am offering such examples here to link Bronowski's belief in the communality of human experience in science and art. Even more, to bring together science, art, and the humanistic psychology of such men as Abraham Maslow.

Figure 3.2 Abraham Maslow (1908 – 1970)
In the terminology of the humanistic psychologist like Maslow, the phrase Being Cognition means that a person is aware of him or herself above the everyday concerns. This means that all of a situation can be seen as it is. As the study of Blake progresses, the similarity between Blake's qualities as a poet will be seen to parallel the qualities of a scientist.

Blake's work covers paintings, etchings, poetry, and his prophetic books. Bronowski says: "this is not a book about Blake's designs; for I am not fitted to look at them with the pleasure and the care with which I read his writing" (Bronowski, 1958, p18). These sentiments of Bronowski, I too share, in that I am not skilled enough to comment on Blake's etchings and paintings. However, I have included a number of Blake's designs at various points in this chapter to illustrate his work - an example of his visual imagery is a page from his prophetic book America, overleaf. I have also looked through David Bindman's "The Complete Graphic Works of William Blake" (Bindman, 1978), and selected a variety of the etchings from this book, to show Blake's pictorial as well as verbal imagination. The range of Blake's work left me amazed at his imaginative productivity.

Blake's poetry ranges from the early, happy, youthful, Poetical Sketches, to the perceptive Songs of Innocence, and Songs of Experience, to the Auguries of Innocence. Then there are a variety of prophetic books which are at times confusing and bewildering in the range and constantly changing symbols, a procedure paying compliment to the power of Blake's imagery and a technique which he used to protect himself against the fact that he was dissenting against aspects of the Industrial Revolution, such as the 'Satanic Mills', and against the authoritarian religion of the State. In the course of his life, Blake came to propose a softer religion using Jesus the gentle lamb, with comments on the dissenting stern Wesleyan religion that was emerging. Then there are works such as the almost Alice in Wonderland-like tales of the Book of Theil which has soft sexual imagery, to the smoky, lurid and powerful Vala or The Four Zoas describing the 'mutilation' of people being enslaved in their work in the iron foundries and in the cotton mills. There are, too, prophetic books that deal with the uprisings of the deprived and damaged working people. This was the
time of the Luddites. Words like "rage", "flame", "flare", "thunder", "terror", "red hot", "human flaming", "slavery", and so on, give vibrancy to his pages.

Some of Blake's words are mysterious and seemingly meaningless. Blake invented these, which contributed to his reputation of being mad: these include Ahania - female; Vala also female; Luva - male, scorned by Vala; Urizen is Almighty God in various guises; Enian is female; Tharmus (thunder) is male; O Los is our beloved Father, or represents universal humanity; Los are the iron foundries; O lovely Eritharmion is female; Orc is female; Four Zoas are variously four churches, four disciples, or four sons; Golgolroozza is the city of Art and Manufacture; bellows represent the human lung; hammer is the heart; furnaces are the stomach. Blake's imagery in using parts of the human body to describe components of the iron mills is distinctive and illustrates his wide ranging imagination. To further confuse the reader and the authorities, Los can mean Time, while Eritharmon can mean space.

Figure 3.3 A page from Blake's early Prophetic Book “America”. 
Blake was a man who in the course of his seventy years lived in and within his times, in the way in which AH Maslow described the practical self actualizing person (Maslow, 1971). The word practical may seem at odds with what I have already said about Blake as a man of powerful imagination, but Blake did lead a practical life. Much of it was spent in trying to sell his poetry; seeking commissions from his friends; pursuing payment for his etchings; being concerned with his own health, and the health of his wife; and attending to his day to day living. One of his friends was taken aback on one occasion when he alleged he saw Blake and his wife in their house, both naked, reading the poetry of John Milton.

It seemed to me that Bronowski revered Blake as a courageous man of dissent, pursuing truth and the dignity of labour, and dignifying labour in the pursuit of truth, ultimately to enhance the value of being human.

Bronowski wrote "Blake belonged to the dissenting masters of crafts, and men by trade, by stock, and by tradition" (Bronowski, 1972, p143). Blake typified the Age of Revolution because of his personal historical background, as well as by his trade and his personal dislike, rather more his hatred, of the injuries done to the working men and women and to the children, by the Establishment institutions. The injuries dehumanized those people into things.

Blake could not be other than he was, a man of his time, just as Ernest Rutherford, the "master craftsman", was a man of his time during the emerging awareness of quantum mechanics at the Cavendish laboratory some two hundred years later.

Rutherford, born in New Zealand, the son of a Scottish immigrant farmer came to England and displayed such constructive skills with the apparatus of his laboratory that he could well have been regarded as a dissenting craftsman like the craftsmen of the industrial revolution. This thought gives an interesting example of one of Bronowski's beliefs that the imagination in the sciences - in this instance, Rutherford - and in the humanities - through William Blake - emerge from the same creative imagination.
Both were men who saw through social pretence. Rutherford conducted his pioneering experiments on very low budgets, and although he prided himself on his elevation to the peerage, he was known to have little patience or tolerance towards some members of the British establishment. The ‘Talk Softly Please’ sign was said to have been erected by his colleagues in the laboratory in the hope that Rutherford would moderate his booming voice when he was talking to them.

\[\text{Figure 3.4 'Talk Softly, Please'.}\]

The early references to poetry in chapter two and in this chapter are part of the overall plan of study of Bronowski’s passions, beliefs and values. In his comments about the new physics of the twentieth century, there is a reference to a key belief of Bronowski, about the communality of the creative imagination in science and the humanities (Bronowski, 1972).

As Bronowski himself puts it: "The cast of mind which searches, which questions, which dissents, has a great history. Each society has given it its own form: religious, literary, scientific. Much of the strength of Blake derives from
the two-fold form which dissent took in his time; rational, inspired" (Bronowski, 1972 p188).

3.2 A Selection of Poetical and Prophetic Works of William Blake.

Before proceeding to Blake's philosophy of fulfilment, which is the essence of Blake that attracts me most, I would like to present a small selection of some of his poetical and prophetic works.

From the early Poetical Sketches of 1783, when Blake was 26 years of age comes this poem:

To Spring

O Thou, with dewy locks, who lookest down
Through the clear windows of the morning; turn
Thine angel eyes upon our western isle,
Which in full choir hails thy approach, O Spring!

The hills tell each other, and the list'ning
Vallies hear; all our longing eyes are turned
Up to thy bright pavilions: issue forth,
And let thy holy feet visit our clime.

Come o'er the eastern hills, and let our winds
Kiss thy perfumed garments; let us taste
Thy morn and evening breath; scatter thy pearls
Upon our love-sick land that
Mourns for thee.

O deck her forth with thy fair fingers; pour
Thy soft kisses on her bosom; and put
Thy golden crown upon her languish'd head,
Whose modest tresses were bound up for thee!

(Blake, in Bronowski, 1958, p16).

Already Blake's sensuality, sensitivity and gentleness to natural events, openness to experience and his freedom with words are apparent. In these qualities of expression Blake can be characterized in modern day thinking as the self actualizing person, a man able to transcend the obvious, enjoy his own experiences, and show his humanness.
In 1789, the year of the French Revolution, when Blake was hopeful of good social outcomes, and when the disruptive effects of the industrial revolution were being felt in England, he wrote his *Songs of Innocence*. The style of these songs is in a "simpler speech which is more searching, and an imagery more moving and more vivid" (Bronowski, 1972, p180), than that of the Methodist revival, a dissenting, religious movement developing at that time.

The first of the Songs of Innocence, begin with:

*Introduction*

_Piping down the valleys wild,_  
_Piping songs of pleasant glee,_  
_On a cloud I saw a child,_  
_And he laughing said to me:_

>'Pipe a song about a Lamb!'  
_So I piped with merry cheer._  
>'Piper, pipe that song again;'  
_So I piped: he wept to hear._

>'Drop thy pipe, thy happy pipe,_  
'Sing thy songs of happy cheer:'  
_So I sung the same again,_  
_While he wept with joy to hear._

>'Piper, sit thee down and write'  
_'In a book that all may read.'_  
_So he vanish'd from my sight,_  
_And I pluck'd a hollow reed._

_And I made a rural pen,_  
_And I stain'd the water clear,_  
_And I wrote my happy songs_  
_Every child may joy to hear._

(Blake, in Bronowski, 1958, p26).

Here are Blake's qualities of spontaneity, joyfulness, goodwill, and tenderness in innocence. The quality of innocence, he came to regard as essential for an adult to retain throughout life, alongside experience. This is a fundamental feature of his beliefs about a fulfilling life.
Also from *Songs of Innocence* there is a poem entitled

**Infant Joy.**

'I have no name:
'I am but two days old.'
What shall I call thee?
'I happy am,
'Joy is my name.'
Sweet joy befall thee!

Pretty joy!

Sweet joy but two days old,
Sweet joy I call thee:
Thou dost smile,
I sing the while,
Sweet joy befall thee!

(Blake, in Bronowski, 1958, pp37 - 38).

Figure 3.5 Title "Infant Joy".
Figure 3.6 Blake’s Etchings from “Songs of Innocence”
The openness and sense of freedom in *Infant Joy* is so timeless that this poem could be spoken to an infant today, and could be contrasted with the next poem *Infant Sorrow*, from the Songs of Experience. The dialectic of innocence and experience forms the basic progression of human life for Blake.

Here is *Infant Sorrow*, from the Songs of Experience, dated 1794.

*Infant Sorrow*

My mother groan'd My father wept.
Into the dangerous world I leapt:
Helpless, naked, piping loud:
Like a fiend hid in a cloud.

Struggling in my father's hands,
Striving against my swaddling bands.
Bound and weary I thought best
To sulk upon my mother's breast

(Blake, in Bronowski, 1958, p54).

Here is the conflict between the child and the parents, especially the struggle between the child and the father. In Blake's thinking, expressed in a number of poems, the male child in the process of growing up, inevitably murders the father. For me, brought up in my university studies, in 1947 - 1950, with the belief that Freud was the first man to develop this concept, it adds to the fascination of Blake, to think that he is pre-dating the Freudian-Oedipal complex.

In a later prophetic book, this struggle or conflict emerges between the people and Urizen, variously Almighty God, who "thumps on the head" as Blake puts it. Urizen represents the State, the experienced adult named by Blake as the hypocrite, and the child is the gentle lamb Jesus, who grows into a significant adult influence. In keeping with Blake's changes of imagery, Urizen can represent the master craftsman of the world. In the etching, Urizen is spanning the dissident class of craftsman with his compass.
Moving in time to the period between 1804 - 1808, Blake wrote in a rational optimistic style, the prophetic book *Milton*. The following lines are perhaps some of Blake's most well-known work:
Milton

And did those feet in ancient time
Walk upon England's mountains green?
And was the holy Lamb of God
On England's pleasant pastures seen?

And did the Countenance Divine
Shine forth upon our clouded hills?
And was Jerusalem builded here
Among these dark Satanic Mills?

Bring me my Bow of Burning Gold:
Bring me my Arrows of desire:
Bring me my Spear: O clouds unfold!
Bring me my Chariot of fire.

I will not cease from Mental Fight
Nor shall my Sword sleep in my hand
Till we have built Jerusalem
In England's green and pleasant Land

(Blake, in Bronowski, 1958, p162).

Figure 3.8 The first page from “Milton Book the First".
Here the older Blake, now in his fifties, having lived through the French revolution, and the unhappy consequences of the rise of Napoleon, having, 'seen' the Satanic Mills pollute the people and the countryside of England, such as Wilkinson's iron furnaces in the Derbyshire Hills, (although Blake never moved further than the north of London), had turned to Biblical themes. Especially, Jerusalem, in *Milton the First*, was regarded as emination or salvation.

The famous lines from *Milton the First* about "England's green and pleasant land", must surely have been one of the reasons at least why Bronowski spent what time he had available to him from his wartime researches in World War II, writing *William Blake. A Man without a Mask* in the initial edition of 1942. Bronowski must have felt a sense of hope in Blake. Bronowski in his time was seeing daily the mutilation of people and the country of England, yet could reach beyond that into the timeless goodness of man, so he himself must have hoped for the goodness of man to emerge beyond the events of the destruction in World War II. It must have justified Bronowski's belief in great poets as communicating universal, absolute, and direct experience.

### 3.3 Blake’s Writings and Concept of the World Structure

With this broad survey of Blake in mind, it is now time to pay closer attention to the turbulence of England during the Industrial Revolution, wherein Bronowski emphasises the social, political and technological upheavals. After Bronowski’s survey, this study will then present Blake's philosophy of personal fulfilment, man's vision's thwarted, and the need to develop visions again.

Bronowski puts it well when he says "Blake speaks the discontent of his time. Until we know the discontent, we do not begin to read his writings, because we do not speak their language." (Bronowski, 1972, p179). So a more intense account of the times is required.

Bronowski wrote: "the massive expansion of manufacture by machines about the year 1800 obviously changed the economy of England. And more subtly it changed the way in which man looked at the economy, and their own place in
it. So long as men worked in villages, they thought of their livelihood as a gift: a gift from God as from nature" (Bronowski, 1972, p15).

The cottage weaver had his own loom and his own patch of land, and his life was as much an Act of God as anything else. In a way, this is curiously like John Dryden's Nature as the root passion of mind as Ideal giving order to society.

For some time society had been changing in such a way, that as Bronowski graphically put it: "William Blake lived in the most violent age of English history. Its revolution had long been gathering speed. Industry was grouping itself afresh, the new farming (as a result of the land enclosure acts) forcing the villager off his patch of land, the population was growing ... "(Bronowski, 1972, p173).

The upheaval took place against the settled age of the mercantile Whig society of the previous century. Isaac Newton's *Principia* had been published in 1687, with its emphasis on a rational orderliness. Richard Bentley, said to be the greatest of the Whig scholars, a cleric, and also described as a bullying type of man, was propagating Newtonian Rationalism, and made the Laws of Gravitation into the Eternal Laws of Gravitation. Using Newton for religious control was one of the ways that the Whigs could present Nature in society, in a fixed way. The Whigs made Newtonian orderliness into social rigidity in order to control the working people.

Blake disliked the rigidity and the abstract nature of the way Newton's world had been made. Fritjof Capra in his most recent book, wrote of William Blake: "the great mystical poet and painter who exerted a strong influence on English Romanticism was a passionate critic of Newton". Capra described Blake's view with these celebrated lines:

\[
\textit{May God us keep} \\
\textit{From single vision and Newton's sleep.} \\
\text{(Blake, in Capra, 1997, pp20 - 21).}
\]

Francis Bacon and John Locke also influenced the formation of the systematic abstract world of the time. Bacon gave humans power over Nature by
understanding nature in a rational way, not in a mystical fashion; while John Locke promoted the Whig cause of privilege and rational control by his view of society as a let-be mechanical structure for the educated class.

By way of a strong contrast Blake's universe is described by Bronowski: "To Blake the thing must remain itself in its most 'Minute Particulars,' as itself because these are its particulars alone" (Bronowski, 1972, p138).

In Newton's universe the system of planetary movement from which Blake got the idea of the Mills, is held together by interacting gravitational forces. \( F = \frac{G m_1 m_2}{d^2} \). Bronowski continues "Blake wanted a universe of a piece, which held together, in the large and in the small, of itself. In place of mechanics, such a construct must have a geometry of its own. Blake worked out this geometry" (Bronowski, 1972, p138). This notion of the construct which must have a geometry of its own integrated into his particular view of a world system, is part of Blake's need to convey the sense of unity in his perception of an earthly system.

Blake himself said "The nature of infinity is this. That everything has its Own Vortex and when once a traveller through Eternity, has passed that Vortex he perceives it roll backward behind, his path into a globe unfolding.

The Vegetative Universe opens like a flower from the Earth's centre, in which is Eternity. It expands in stars to the Mundane Shell. And there it meets Eternity again, both within and without" (Blake in Bronowski, 1972, p128).

Blake himself conveyed the concave shell in his statement:

**The Mundane Shell**

_The Mundane Shell is a vast Concave Earth, an immense Harden'd Shadow of all things upon our Vegetated Earth. Enlarg'd into Dimension and deform'd into indefinite Space, In Twenty-seven Heavens and all their Hells with Chaos And Ancient Night and Purgatory. It is a cavernous Earth Of Labyrinthine intricacy, twenty-seven folds of Opaqueness, And finishes where the lark mounts_

(Blake, in Wordsworth Poetry Library, 1994, p283).
Bronowski said of Blake's conception of The Mundane Shell, "This is a remarkable construct for Blake to have pictured, for it cannot be put into a space of only three dimensions. And Blake knew this when he said 'The Mundane Shell is a vast Concave Earth ...'" (Blake, in Bronowski, 1972, p128). The Mundane Shell can be regarded as "the ultimate limit ... (in) the holistic perceiving of the cosmos as a unity" (Maslow, 1971, p263). This statement from Maslow during his discussion of transcendent personalities is an instance of Blake as the mystic visionary. The interaction of the Twenty Seven Heavens and their Hells into Chaos, a line from The Mundane Shell supports both Bronowski and Maslow about the holistic, cosmological mysticism that Blake could express. Written today as an account of the four dimensional concept of space-time, it could well at first glance be thought nonsense. But it does bear a touch of the Einsteinian mystery about the universe, and to this extent Blake is again showing his quality of timelessness.
Not only is Blake's conception of the 'Concave Earth' and 'Mundane Shell' a fascinating contrast to the abstract rigidities that the Whigs made use of Newtonian mechanics but, even more, they are splendid examples of Blake's personal initiative and courage in expressing his ideas. In the Wordsworth Poetry Library edition there is the statement:

"Blake's abiding perception that 'everything lives is Holy' sustained him through to his own death. Founder and follower of no school, he expressed a unique and vital view:

I Must Create a System or be enslav'd by another Man's
I will not Reason and Compare: my business is to Create"

(Blake, in Wordsworth Poetry Library, 1994, pix).

This is remarkable testimony to Blake as a self actualizing person with the fundamental quality of freedom from enculturation, creativeness, and the essential quality of Transcendence. These are some of the qualities so highly prized by such modern humanistic psychologists as Abraham Maslow, and relate to Bronowski's belief of the communality of the creative imagination between the arts and the sciences.

Blake's unique powers of visionary thinking and self expression are well described by Maslow who says: "This person is the best one in the whole world for this particular job, and this particular job is the best job in the whole world for this particular person and his talents, capacities, and tastes. He was meant for it, and it was meant for him" (Maslow, 1971, p294).

3.4 Blake's Vivid Symbols.

As Bronowski is often at pains to emphasize in his study of Blake and the Industrial Revolution, the atmosphere of England at this time was rife with dissenters of various kinds, reacting by rejecting the Whig rationality. There developed the machinery makers, the iron masters of the 'Satanic' mills. As I have noted, Blake used the word 'mills' more to represent the idea of the fixed orbits of the rotating planetary system than the idea of the mill as a part of the grinding machinery. The factory owners, particularly those operating the cotton mills, forced women and children into production lines, working long hours
and walking long distances to the factory. There were bridge builders, lighthouse builders, canal builders, road makers, changing the whole landscape of England. These men, with their mechanical inventions, not only changed the framework of the English countryside but changed the behaviour of the men and the women as well as their children. It is the effect on the humans caught up in these changes which Blake characterized as ‘mutilation’, that aroused his passions against the factory owners.

I have inserted the photograph of the little bridge over the river Severn at Coalbrookdale from *The Ascent of Man*, as a striking and graceful example of how the Industrial Revolution changed the English countryside. The bridge in relation to the countryside is so tranquil that it is both useful and aesthetic. The fact that Bronowski includes such a photograph is a feature of his optimism about the world, in that despite the brutality of the industrial revolution, and the brutality of events in World War II, he always had a sense of optimism about the qualities of humans to enhance human life.
There were dissenters of another kind who had long been developing and came to prominence in the Tory society of George III. Representative of these religious dissenters were John and Charles Wesley, who preached "mysterious submission" and "sin and stern repentance" (Bronowski, 1972, p145), meant to control the lower orders of society.

Bronowski sums up the situation of change when he points out "The machines changed the organization of society, and shifted the centre of man's life from his cottage home to the daily factory, and the man ceased to be a member of his family and village, and in the long run, became simply himself, a person" (Bronowski, 1972, p 95).

This latter feature of the man becoming simply himself cannot be emphasised too much, since it has evolved right down to the present day, late in the twentieth century, when people are responsible for themselves and humans know themselves best, or as Abraham Maslow asserts "What humans can be, they must be" (Sarfaty, 1993, p35). This theme runs through all the Second Force of psychology expressed in the psychoanalysis of Sigmund Freud up to the Third Force of the humanist psychologists which includes Carl Rogers and Abraham Maslow. My own study of the Self Actualizing Person of Niels Bohr is an example of modern day thinking of individuality (Sarfaty, 1993).

At the time of the Industrial Revolution, particularly from 1760 to 1815, and, if the upheavals of the American and French Revolutions are included - and Bronowski does include them - "the machine ... regulated and brutalized and starved him, it exploited him and (for a long time) his family, and it robbed him, who was an ordinary man, of everything but his skill" (Bronowski, 1972, p5).

Bronowski writes with passion about the destruction of human dignity by the denigration of people to labour as a result of the development of the machine. This leads him to prize Blake's own sensitive response - the philosophy of fulfilment - which recognizes the continual thwarting of people's visions and the continuing hope of regeneration.
An irony of Blake’s position as a dissenter was that he objected to the activities of other kinds of dissenters, in particular the powerful machine making kind. John Wilkinson the ironmaster, was so powerful that he paid his workers with coinage stamped in his own image. The picture of John Wilkinson, shows the coinage Wilkinson minted. As Bronowski said in his caption: "Iron masters like John Wilkinson minted their own wage tokens, with their own unroyal faces on them" (Bronowski, 1973, p274). The Tory government of the time with the royal personage of George III was quite unaware of the power of men like Wilkinson.

![Figure 3.11 John Wilkinson coinage](image)

There were the ‘Satanic’ mills of the Darbys in the Darbyshire hills. Matthew Bolton and James Watt, the engine makers, revolutionized mine producing machinery by making accurate and reliable steam engines for pumping water from the depths of the mines. They replaced the unreliable Newcomen steam engine and were an example of the increasingly accurate craftsmanship of the time. Arkwright developed the spinning jenny for the cotton looms.

Josiah Wedgwood built a gauge which allowed him to measure high temperatures in his kilns. His pottery-ware, especially the simple cup and saucer and teapot, were cheap and plentiful and spread through wide markets.
The photographs show crockery produced by the Wedgwood factories, which as Bronowski pointed out: "The creamware ... made Wedgwood famous, (and) transformed the kitchens of the working classes in the Industrial Revolution". (Bronowski, 1973, p276).

Figure 3.12 Wedgwood crockery

With a sense of optimism which was part of Bronowski's values about the growth of human wellbeing, he comments that good came from the ironmasters, because women could give birth to their children on a iron bedstead instead of the earth floors of their homes, thus reducing the possibility of childbirth fever. The working class housewives could afford the teapot and cups and saucers to bring some sort of order and living style into their homes.
The cotton mills produced cheap cotton dresses, giving women a better range of clothing. One of the personal pleasures that I have experienced in writing the chapter is the way it covers so many facets of human life. There are discussions of Blake and his work, the three revolutions, and the various benefits, as well as the "mutilations" resulting from them. It demonstrates the depth of Bronowski's interest in human life.

Men like Wilkinson, Boulton, Watt, Arkwright, Wedgwood, and the Darbys, are examples - as was William Blake himself - of strong minded independent men, who were self determined in their new goals. Blake recognized their power as master craftsmen when he etched Urizen as the craftsman with his compasses influencing the world.

All these various dissenters - the mechanical machine inventors, the religious dissenters and the social humanitarian dissenters like Blake, all defied the smug pronouncement of John Locke at the beginning of the Whig age that "Knowledge and science in general are the business only of those at ease and leisure" (Bronowski, 1972, p148).

It is also valuable to reflect back to John Dryden, and Dryden's colleague, the architect Christopher Wren, both of whom were non-scientists who held significant positions in the Royal Society.

The common thread of dissent runs through the social, humanitarian (Blake), religious (Wesleys), and mechanical technologists (Wilkinson, Darbys, Boulton, Watts, and others), and all were thinkers about Nature in a rational cause-effect manner. It does lend strength to Bronowski's principal belief that the creative imagination generates knowledge in the natural sciences and the humanities. This is the significance of mentioning Dryden the poet and Wren the architect as members of the scientific institution, the Royal Society.

The government in London had little awareness or understanding of the technological-industrial developments in England during the period of the late eighteenth and early nineteenth centuries. The government was helpless to stem the growing powerful changes, especially when working men began to revolt
against the loss of respect shown for them as whole men with a sense of purpose, not just factory hands. I used the term "men" here not as an out-of-date gender discrimination, but because it was the men who lost their roles as agricultural labourers and as cottage wool spinners. As the factories developed, especially the cotton mills, women and children were used more than men.

The government became repressive by passing Sedition Acts, and suspending Habeas Corpus, an event which is still significant history is the massacre of rioting workers at St Peter's Fields near Manchester in the early nineteenth century. The government named the massacre Peterloo. The workers were not so much anti-machines, as rioting against the factory owners, who set the poor conditions of work. As well, the government passed Combination Laws to try and stop the gathering of workers. Corresponding Societies were considered threats to the stability to the State and the growth of industry, whether the Societies were of the lower classes or of the upper.

The late eighteenth century saw the rise of gambling, State lotteries to raise taxes, underwriters offices, and racecourses came into being. The institution of the Stock Exchange emerged as the practice of share capital invested in industry developed. The general social disorder in England during the time of George III (1760 - 1820), saw gin drinking as a common habit amongst the populace, and highwaymen were wished well on their way by the "ladies" of London Town. These features of a self-seeking and repressive and disorderly society were known to William Blake.

3.5 Blake’s “Time Hatreds.”

The advantages and disadvantages of science and technology as it affects human lives, is a theme which occurs often in Bronowski's writings, particularly in his later years. An obvious example from our own era is the contrast between the goodwill among the scientists of different nations who gathered at Niels Bohr's Copenhagen Institute in the 1920's and 30's, to debate and comprehend the behaviour of atomic particles in the act of fission, and the report of Bronowski which he wrote shortly after World War II when he visited Nagasaki as scientific deputy to the British Chiefs of Staff's mission to
Nagasaki. The report entitled *Effects of Atomic Bombs on Hiroshima and Nagasaki* (Bronowski, 1946), gives horrific pictorial and verbal accounts of the effect of atomic bombs on the people and the physical structures of the two cities. In a real sense the dilemma which always baffles us is an example of the vision of scientists like Niels Bohr and Albert Einstein, and then their vision frustrated by the destructive use of the technology from their work, in our own time.

To read Bronowski's four works on William Blake - the 1942, 1944, 1958, and 1972 publications - is to know Bronowski's "chariot of fire"; his passions for social, political and humanitarian issues. Just so, did Blake ride his "chariot of fire" with special determination, when he knew of the failure of the French Revolution in 1789 which did not enhance the lives of people, since it did not free them from repressive authority. He could also perceive the effect of the industrial revolution on England, which we would consider today as responsible for environmental pollution.

Bronowski records that Blake had "two hatreds - hatred of the dehumanized machine, and hatred of war" (Bronowski, 1972, p14). Bronowski quotes from a prophetic book of Blake's to illustrate the intensity of the poet's hatred:

> And Los, Furnaces howl loud, living self-moving, lamenting  
> With fury and despair, and they stretch from South to North  
> Thro' all the Four Points, Lo! The Labourers at the Furnaces,  
> Rintrah and Palamabron, Theotormon and Bromion, loud lab'ring  
> With the innumerable multitudes of Golgonooza round the Anvils  
> Of Death! But how they came forth from the Furnaces, and how long  
> Vast and severe the anguish e'er they knew their Father, were Long to tell; and  
> of the iron rollers, golden axle-trees and yokes  
> Of brass, iron chains and braces, and the gold, silver and brass,  
> Mingled or separate, for swords, arrows, cannons, mortars,  
> The terrible ball, the wedge, the long sounding hammer of destruction,  
> The sounding flail to thresh, the winnow to winnow kingdoms,  
> The water wheel and mill of many innumerable wheels resistless,  
> Over the Four fold Monarchy from Earth to the Mundane Shell  
> (Blake, in Bronowski, 1972, pp 14-15).

These lines, lurid, violent with the making of the weapons of war, outlandish place names deliberately invented by Blake - partly to disguise his intentions -
and full of the industrial and military activity of his times, are characteristic of some of his prophetic books. The manufacturing activity of weapons of war anticipates the military industrial activity of the Great War, and is an example of Blake responding to his own times, but seeing ahead to future wars such as the Great War of 1914 - 1918.

As examples of Blake's inventiveness, there are the words Los which can be a male character, Our beloved Father or a symbol for universal humanity; Golgonoonza is a city of Arts and Manufactures, a disguise for London.

In a similar way in the prophetic book "Vala or the Four Zoas" there are powerfully violent visions about the mutilations done to people. For example:

'O Lord, wilt thou not look upon our sore afflictions
'Among these flames incessant labouring? Our hard masters laugh
'At all our sorrow. We are made to turn the wheel for water,
'To carry the heavy basket on our scorched shoulders, to sift
'The sand and ashes, and to mix the clay with tears and repentance.
'The times are now return'd upon us; we have given ourselves
'To scorn, and now are scorned by the slaves of our enemies.
'Our beauty is cover'd over with clay and ashes, and our backs
'Furrow'd with whips, and our flesh bruised with the heavy basket.
'Forgive us O thou piteous one whom we have offended! Forgive
'The weak remaining shadow of Vala that returns in sorrow to thee'  

(Blake, in Bronowski, 1958, p141).

Blake grieves for the mutilation done to the "slaves". His reference to "wheel for water" is not only the water wheel, and the "mill of many immutable wheels" is not only literally the wheels of machines, but it also is a reference to the planetary wheels. This means the movement of the planets in Newton's system, which Blake regarded as too abstract and rational to be accepted for human understanding. The abstraction suited only the establishment rationality for social control, begun by the Whigs.

Bronowski asserts of Blake that: "Through all his poems, there sounds the iron footsteps of the modern age, war, oppression, the machine, poverty, and the loss of personality" (Bronowski, 1972, p16). Although Bronowski wrote his comments in 1965, when he first finished William Blake and the Age of
Revolution, now in the late 1990's, fears of exploitation, war, repressive governments, and technologically destructive weapons still prevail. The Great War which was fostered by industrial activity, has been already referred to. These situations support Bronowski's contention that Blake responded to the time of his age, and to the timeless, and thus Blake does offer universal, absolute and direct experience out of his own visions. In effect, like the great poets, Blake was direct in response to events around him; universal - meaning cross cultural; and absolute - meaning that he dealt with fundamental understanding about human motivation. I am reminded here of the perceptive sadness that runs through Yeats' political poems.

The examples from the prophetic books, together with the examples of poetry provided so far in this chapter, are evidence for Bronowski's contention that Blake's thought on human fulfilment begins with the belief "at the evil, that society thwarts the fulfilment of man" (Blake, in Bronowski, 1972 p180). I think of the Islamic wars today in the Middle East, and arbitrary laws in some countries such as Africa which denies individual respect for humans. The blight is established religion, law, government, and the mechanical 'let be' society. Thus says Blake "religion thwarts Christ ... law thwarts Desire gratified ... man made famine thwarts the plenty which men make" (Blake, in Bronowski, 1972, p180).

Blake's intense insight into human affairs is demonstrated by his observation "some say that Happiness is not Good for mortals, and they ought to be answered that Sorrow is not fit for Immortals and is utterly useless to anyone, a blight never does good to a tree, and if a blight kill not a tree, but it still bears fruit, let no one say that the fruit was in consequence of the blight" (Blake, in Bronowski, 1972, p180). What a pithy observation.

Bronowski would have had deep empathy with the sentiments of Blake that the blight must be fought within society, since a belief of Bronowski's was that man must accept responsibility for the pursuit of Truth and the dignity of labour in its pursuit. Like Blake, Bronowski regarded society as a means to human wellbeing, not an end. As Blake expressed it "Man must be set free to make his good. But he must still make his good himself" (Blake, in Bronowski,
Hence Blake's fierce opposition to the mutilation of people by the machine, by State restrictive laws, and by established religion - Urizen - which indulged the privileged, and repressed the disadvantaged.

In the lines which follow from *Desire Ungratified*, Blake was forthright against this repression, as was Sigmund Freud in modern times.

*In a wife I would desire*
*What in whores is always found -*
*The lineaments of Gratified desire.*

*Abstinence sows sand all over*
*The ruddy limbs and flaming hair*
*But Desire Gratified*
*Plants fruits of life and beauty there*.

(Blake, in Bronowski, 1972, p179)

In effect restriction blights the blossoming of the tree of life.

According to Blake, revolutions whether political like the French, or the opposition of workers to their personal exploitation by the drudgery of machine life by the rioters like the Luddites, "can free man from self interest, they have freed man to remake himself". (Blake, in Bronowski, 1972, p180).

In the development of Blake's philosophy comes a vital thought: "that a society remade will remain a society to be remade" (Blake, in Bronowski, 1972, p181). At first thought this seems a bleak principle, but it is an essential part of Blake's view that there is a constant struggle to make, to be thwarted, and to remake the human being. This is the concept of the word "innocence" and the word "experience", two key words in Blake's poetry and prophecies being the struggle of the child to be the father, meaning to be an adult, society to be constantly improved, driven always by the "will to good" (Bronowski, 1972, p181). To read modern humanist psychologists like Maslow, and especially to consider Maslow's provocative statement that history has always sold man short, thwarting man's natural will to be a self actualizing human, to express man's humanity to the full, is again to realize how timeless was the thinking of Blake.
As Blake put it: people have visions and any attempt to put the vision to action distorts the vision. This is reminiscent of Philip Sidney's account of the interaction of the infected wil and erected wit inherent in the struggle of man to deal with ethical values. People are thwarted and the struggle to remake the vision starts again. People at their natural best are continually moving between innocence and experience, the 'hypocrite', who always angered Blake and yet aroused him to hope at the same time, because experience of life makes people more aware of good. So Blake developed the dialectic, the constant progression of innocence and experience as the basis of his philosophy of living an adult life.

The nobility of Blake emerges when he put man and God together into the Soul of man. He said "imagination is the Divine Vision not of the World or of Man, nor of Man as he is a Natural Man, but only as he is a Spiritual Man" (Blake, in Bronowski, 1972, p182). Bronowski comments "this is the faith of every great poet from Philip Sidney to Blake. The mystic in Blake seeking the one in the many" ... and "the revolutionary seeking man in his societies" (Bronowski, 1972, p182), wanting the well-being of the individual man or woman to come together when Blake says:

"God only Acts and Is, in existing beings or men. Therefore God becomes as we are, that we may be as he is" (Blake, in Bronowski, 1972, p182). This shows Blake as a religious man but not accepting a repressive Christianity.

This is the constant visionary drive, of those thwarted, the progression and innocence, the dialectic which drove Blake all his adult life, to speak out despite restrictive laws, especially in the later years of the reign of George III's Tory society, as well as in the earlier Whig times. This despite Blake's own distress over his trial in 1803 on a charge of sedition against the Crown, from which he was acquitted in 1804. The charge was described as a "malicious act of treason against the Crown" made by a soldier with whom Blake had exchanged words about the soldier being in his garden while Blake was "holidaying" at Felpham on the south coast of England. Bronowski adds that the mutinous attitudes of the working class in England at the time were so heightened, that had Blake lived in the north of England, amongst the mills, he
would have been convicted as a matter of course. Although acquitted, the trial left Blake frightened.

3.6  Blake's Dialectic.

Blake's dialectic is the act of integration between child and parent, child into adult, the face and the mask, the centre and the circumference, the id and the ego. The unity in Blake's philosophy bears a striking resemblance to Ruth Benedict's concept of synergy in society and the individual. Benedict, an American anthropologist (1887 - 1948), reported in Maslow (1971), developed the concept of the synergistic society as one where mutuality of relations among people in a society advantages society overall. Most societies move between high and low synergy actions, and Blake's society, his vision and its thwarting by mechanical, economical and political forces, is quite like the mixed synergy of our own times.

The movement of money by individuals and organizations to 'tax havens' overseas, to avoid income tax in current societies, is a good example of the low synergy society. Abraham Maslow considers Benedict's concept is not adequately appreciated. (Maslow, 1971, pp191 - 202). The reference to the synergistic society could be applied to the society of Blake's time, and moves forward timelessly to our own times in the late twentieth century. I have introduced Benedict's term "synergistic society" more in a passing reference than for any depth discussion, simply to show how universal and expressive descriptions of human affairs can be.

God was an ever changing idea in Blake's writing, as he reacted to the changing forces in his own times. Early in his life he accepted the Almighty God of the Old Testament, whom he named Urizen: afterwards Urizen became symbolic of a brutal force which caused "Thumps (to) people on the head", the type of God who appears in the prophetic books of the Satanic Mills such as in *Vala or The Four Zoas*. Yet Urizen is also highly regarded by Blake as the symbol of the master craftsman, and Blake's etching of Urizen has his compasses spread wide representing dissenting inventors. Ultimately, Almighty God, brutal
Urizen gave way to gentle Jesus the lamb, who soothes the hurts of humans and who gives hope for the future.

In *Songs of Innocence*, Blake wrote:

**The Lamb**

*Little Lamb, who made thee?*
*Dost thou know who made thee?*
*Gave thee life, and bid thee feed*
*By the stream and o'er the mead;*
*Gave thee clothing of delight,*
*Softest clothing, woolly, bright;*
*Gave thee such a tender voice,*
*Making all the vales rejoice?*
*Little Lamb, who made thee?*
*Dost thou know who made thee?*

*Little Lamb, I'll tell thee,*
*Little Lamb, I'll tell thee:*
*He is called by thy name,*
*For he calls himself a Lamb.*
*He is meek, and he is mild;*
*He became a little child.*
*I, a child, and thou a lamb,*
*We are called by his name.*
*Little Lamb, God bless thee!*
*Little Lamb, God bless thee!"

(Blake, in Bronowski, 1958, p28).

The God in this poem is a gentle generous One. Here Blake put all the kindnesses of "Piping down the valleys wild" from his early poetical sketches, and "Songs of Innocence". Later this God appears in the prophetic book "Milton" who prophesied Jerusalem built in England's "green and pleasant land" to soothe and heal the personal brutality of his times. (Blake, in Bronowski, 1958, p162).

It is no wonder that Blake was regarded, and still is acknowledged as a complicated visionary, when he variously accepts and rejects God, Almighty God, and Jesus, as he lived through the upheavals of his era, at times cowed, and fearful, causing him to disguise his thoughts with different words. The seditious utterances trial, referred to previously, is one such example.
To continue the Blake philosophy of human fulfilment, Bronowski observes that "Blake saw the Soul as that which is lasting and common in man, to which their common shape is one form: the Human Form Divine. The Human Form Divine alone makes man: the sum of his mind, his feelings, his dignity, his knowledge of truth and of love, his reason in the widest meaning, his belief in his own imagination" (Bronowski, 1972, p183).

There is something of the idea of the godly Virtue of Philip Sidney, the root passion of Nature of John Dryden, and William Wordsworth's root passion in the pleasure of Nature, in Blake's earlier idea of the Human Form Divine as being lasting and common in man. In this way the previous chapter about Bronowski's study on *The Poet's Defence* links to this present chapter about the analysis of the philosophy of William Blake.

The qualities of the Human Form Divine are the qualities that Bronowski himself espouses through his own work, especially as it concerns his thinking in science, arts, creative imagination, ethical matters, and the value of rational thought over unsubtle emotional responses to events.

Blake sets the worth of man in the wonderful lines *The Divine Image*, from *Songs of Innocence* (1789).

\[\text{To Mercy, Pity, Peace, and Love}\
\text{All pray in their distress;}\
\text{And to these virtues of delight}\
\text{Return their thankfulness.}\
\]

\[\text{For Mercy, Pity, Peace, and Love}\
\text{Is God, our father dear,}\
\text{And Mercy, Pity, Peace, and Love}\
\text{Is Man his child and care.}\
\]

\[\text{For Mercy has a human heart,}\
\text{Pity a human face,}\
\text{And Love, the human form divine}\
\text{And Peace the human dress.}\
\]

\[\text{Then every man, of every clime,}\
\text{That prays in his distress,}\
\text{Prays to the human form divine,}\
\text{Love, Mercy, Pity, Peace.}\
\]
And all must love the human form
In heathen, Turk or Jew;
Where Mercy, Love, and Pity dwell,
There God is dwelling too"

(Blake, in Bronowski, 1958, pp33 - 34).

These elevated qualities of the generosity of Blake relate strongly to Bronowski's own values of human endeavour where "truth the ideal and dignity the search for its fulfilment" (Bronowski, 1972, p191). As well, Blake's struggle about vision and vision thwarted and returned to the Divine Image are expressions of Transcendence in his work. Maslow gives a "condensed statement. Transcendence refers to the very highest and most inclusive or holistic levels of human consciousness, behaving and relating, as ends rather than means, to oneself, to significant others, to human beings in general, to other species, to nature, and to the cosmos" (Maslow, 1971, p269). Words such as "holistic", "ends rather than means", "to human beings in general", (this one applied to Blake is included with some reservations), "to nature", and "to the cosmos", seem especially relevant to Blake's outlook and role. They can be taken as characteristics of the universal, absolute, and direct responsiveness of the great poets.

In the course of the seventy years of his life, Blake never moved beyond the north of London, to view the iron furnaces or the cotton mills. He never visited Paris, yet he was able to go beyond the here and now to achieve transcendence in experiencing the revolutionary events of his time.

Maslow offers an example of transcendence surely as powerful as Blake's experiences, an experience akin to "The Divine Image". Maslow writes: "Getting off the merry-go-round; walking through the abattoir without getting bloody; to be clean even in the midst of filth. To transcend advertising means to be above it; to be unaffected by it; to be untouched. In this sense we can transcend all kinds of bondage, slavery ... " (Maslow, 1971, p262). In the same way that Viktor Frankl, Bruno Betelheim (two later prominent psychoanalytic practitioners) could transcend even the (Nazi) concentration camp destructive humiliations. Maslow said: "Use the example of the New York Times front page picture in 1933 of an old Jewish man with a beard being paraded before the
jeering crowd in Berlin in a garbage truck: it was my impression that he had compassion for the crowd, and that he looked upon them with pity and perhaps forgiveness, thinking of them as unfortunate and sick and sub-human. Being independent of other people's evil or ignorance or stupidity or immaturity even when it is directed toward oneself is possible, though very difficult. And yet one can, in such a situation gaze upon a whole situation - including oneself in the midst of the situation - as you are looking upon it objectively, detachedly from a great and impersonal or suprapersonal height" (Maslow, 1971, p216).

Maslow's account of the old Jewish man looking with pity recalls Coleridge's *Ancient Mariner* and Shelley's *Prometheus Unbound*; where love frees Prometheus from the evils of Jupiter, and the Mariner's acceptance of the lowly sea-snakes frees him from his penance. Both the Mariner and Prometheus, as with the old Jewish man, transcend their oppressive situations, and are examples of what Bronowski refers to as universal, absolute, and direct experience. These remarkable examples of the "timeless and the timely", or the sense of destiny with the present, are prominent in the belief of Bronowski in great poets.

Although Bronowski does not include Wordsworth among the poets he values for their ethical consideration, there are instances of Transcendence in Wordsworth to which I think Bronowski does not pay due regard. A powerful example occurs in Wordsworth's poem *The Prelude* in Auden and Pearson, vol iv, p207. The gentle contemplative lines show that Wordsworth was alive within himself.

```
Wisdom and Spirit of the universe!
Thou Soul that art the eternity of thought,
That givest to forms and images a breath
And everlasting motion, not in vain
By day or starlight thus from my first dawn
Of childhood didst thou intertwine for me
The passions that build up our human soul;
Not with the mean and vulgar works of man,
But with high objects, with enduring things -
With life and nature - purifying thus
The elements of feeling and of thought,
```
And sanctifying, by such discipline,  
Both pain and fear, until we recognize  
A grandeur in the beatings of the heart.

Surely "A grandeur in the beatings of the heart" must have sustained the old Jewish man. Here, I believe Bronowski was insufficiently aware of the sensitivities within Wordsworth as a poet, in The Poet's Defence.

It is this quality of B (Being) - Cognition which combines the timely and the timeless, which is expressed in the creative imagination, in the scientific experience as well as in the humanities. Because this is such a central part of Bronowski's philosophy about humans, an example from the sciences is appropriate. Werner Heisenberg's conception of the Indeterminacy Principle is an instance. He went beyond everyday objects to the perception of the behaviour of atomic particles in a way never before conceived.

Another reference to what is meant by the B-Cognition, essential to the appreciation of Blake's philosophy of fulfilment, comes from Albert Einstein: "The most beautiful thing we can experience is the mysterious. It is the source of all true art and science. He to whom this sensation is a stranger who can no longer pause to wonder, and stand rapt in awe is as good as dead: his eyes are closed. The insight into the mystery of life coupled though it be with fear has given rise to religion. To know that which is impenetrable to us really exists, manifesting itself as the highest wisdom and the most radiant beauty which our dull faculties can comprehend only in their most primitive forms - this knowledge, this feeling is at the centre of true religiousness. In this sense, and in this sense only I belong to the ranks of devoutly religious men" (Einstein, 1947, p72).

In the formal sense, Blake was a religious man in the Unitarian dissenting practice, but more than that, he demonstrated through his poetry that he was a forerunner in the religiousness about which Einstein wrote. Consider the opening lines of Auguries of Innocence", said to be written about 1803:

To see a World in a Grain of Sand  
And a Heaven in a Wild Flower,  
Hold Infinity in the palm of your hand  
And Eternity in an hour

(Blake, in Bronowski, 1958, p67).
Referring again to Einstein, he said: "I cannot imagine a God who rewards and punishes the objects of his creation, whose purposes are modelled after our own - a God, in short, who is but a reflection of human frailty ... it is enough for me to contemplate the mystery of conscious life perpetuating itself through all eternity, to reflect on the marvellous structure of the universe, which we dimly perceive, and to try humbly to comprehend even an infinitesimal part of the intelligence manifested in nature" (Einstein, 1947, p72).

Surely Blake is in company with Einstein, the old Jewish man, and the modern humanist psychologist such as Abraham Maslow, all of whom demonstrate absolute, direct, and universal experience, which Bronowski attributes to the great poets.

Wordsworth's line "Wisdom and Spirit of the universe" belongs here too. Further potent examples of the way Blake experienced openness and transcendence, of which humans are capable, are these lines from Songs of Innocence, part of the The Divine Image:

\[
\begin{align*}
\text{To Mercy, Pity, Peace and Love} \\
\text{All pray in their distress;}
\text{And to the virtues of delight} \\
\text{Return their thankfulness}
\end{align*}
\]

(Blake, in Bronowski, 1958, p33).

By way of contrast there is the poem: The Human Abstract Taken from Songs of Experience which shows how "The Divine Image" has grown inhuman through abstracted or detached self interest:

\[
\begin{align*}
Pity could be no more \\
If we did not make somebody poor \\
And Mercy could no more be \\
If all were as happy as we \\
And mutual fear brings Peace \\
Till the selfish Loves increase
\end{align*}
\]

(Blake, in Bronowski, 1958, p53).
Blake emphasizes features of his *Songs of Experience*, when he wrote *A Divine Image*:

\[
\begin{align*}
\text{Cruelty has a Human Heart,} \\
\text{And Jealousy a Human Face,} \\
\text{Terror the Human Form Divine} \\
\text{And Secrecy Human Dress.}
\end{align*}
\]

\[
\begin{align*}
\text{The Human Dress is forged Iron} \\
\text{The Human Form a fiery Forge} \\
\text{The Human Face a Furnace seal'd,} \\
\text{The Human Heart its hungry Gorge}
\end{align*}
\]

(Blake, in Bronowski, 1958, p59).

Chimney sweeping, the cancerous and dangerous occupation for children, which was known to Blake, was the subject of the movement of progression from innocence to experience in the two poems of *The Chimney Sweeper*; one
was in the *Songs of Innocence*, and the other in marked contrast from the *Songs of Experience*. Despite the length of the poem in *Songs of Innocence* it is relevant to relate it in full because it shows Blake's imaginative power, his social concerns and his irony at the plight of the children.

**The Chimney Sweeper**

*When my mother died I was very young,*  
*And my father sold me while yet my tongue*  
*Could scarcely cry 'weep! 'weep! 'weep!''*  
*So your chimneys I sweep, and in soot I sleep.*

There's little Tom Dacre, who cried when his head,  
*That curl'd like a lamb's back, was shav'd: so I said*  
'Hush, Tom! never mind it, for when your head's bare  
'You that the soot cannot spoil your white hair.'

*And so he was quiet, and that very night,*  
*As Tom was a-sleeping, he had such a sight!*  
*That thousands of sweepers, Dick, Joe, Ned, and Jack,*  
*Were all of them lock'd up in coffins of black.*

*And by came an Angel who had a bright key,*  
*And he open'd the coffins and set them all free;*  
*Then down a green plain, leaping, laughing, they ran,*  
*And wash in a river, and shine in the Sun.*

*Then naked and white all their bags left behind,*  
*They rise upon clouds and sport in the wind;*  
*And the Angel told Tom, if he'd be a good boy,*  
*He'd have God for his father, and never want joy.*

*And so Tom awoke; and we rose in the dark,*  
*And got with our bags and our brushes to work.*  
*Tho' the morning was cold, Tom was happy and warm;*  
*So if all do their duty they need not fear harm.*

(Blake, in Bronowski, 1958, pp30 - 31).

Innocence indeed! With Blake's powerful irony about obedience to established values of duty to the establishment God, and State, the poem powerfully describes the indifference of the State to the plight of the children.

Blake becomes relentless in his attack on *God, his Priest and King* on behalf of the "little black thing", the child in "The Chimney Sweeper" from the contrasted *Songs of Experience.*
The Chimney Sweeper

A little black thing among the snow,
Crying 'weep! 'weep!' in notes of woe!
'Where are thy father and mother? say?
'They are both gone up to the church to pray.

'Because I was happy upon the heath,
'And smil'd among the winter's snow
'They cloth'd me in the clothes of death,
'And taught me to sing the notes of woe.

'And because I am happy and dance and sing,
'They think they have done me no injury,
'And are gone to praise God and his Priest and King,
'Who make up a heaven of our misery.'

(Blake, in Bronowski, 1958, p47).

This is a courageous contrast between the powerless children and the authority of the State. It was not until 1834 that boys were set free from chimney sweeping.

Blake's etching of A little black thing is from the Songs of Experience (1794). Blake eloquently describes the misery of the child, as inhuman, a "thing" bereft of personality.

Figure 3.14 Songs of Experience, "The Chimney Sweeper"
Blake uses the dialectical movement between innocence and experience to strong effect in *The Nurse's Song*.

**Nurse's Song** *from Songs of Innocence:*

*When the voices of children are heard on the green*
   *And laughing is heard on the hill,*
   *My heart is at rest within my breast*
   *And everything else is still.*

'Then come home, my children, the sun is gone down
 'And the dews of night arise;
 'Come, come, leave off play, and let us away
 'Till the morning appears in the skies.'

'No, no, let us play, for it is yet day
 'And we cannot go to sleep;
 'Besides, in the sky the little birds fly
 'And the hills are all cover'd with sheep.'

'Well, well, go and play till the light fades away
 'And then go home to bed.'

*The little ones leaped and shouted and laugh'd*
   *And all the hills echoed.*

(Blake, in Bronowski, 1958, p37).

*Figure 3.15 Songs of Innocence, "The Nurse's Song"*
Nature applauds the nurse's generosity in showing kindness, spontaneity and freedom to the children. This poem is quite like the spirit of the *Introduction* (Blake, in Bronowski, 1958, p26) already referred to.

And then the hypocrite, the adult giving the *Nurse's Song* from *Songs of experience*.

*When the voices of children are heard on the green  
  And whisp'ring are in the dale,  
The days of my youth rise fresh in my mind,  
  My face turns green and pale.*

*Then come home, my children, the sun is gone down,  
  And the dews of night arise;  
Your spring and your day are wasted in play,  
  And your winter and night in disguise.*

(Blake, in Bronowski, 1958, pp47 - 48).

Here adult experience generates jealousy and lament, and the spontaneity in children or the innocence of experience "your spirit" are damped down, "wasted", leaving the adult cynical.

But even so, in Blake's philosophy of fulfilment, about the dialectic of innocence and progression to experience of life, the hypocrite's feelings expressed in the line: "the days of my youth rise fresh in my mind" shows that there is still freshness from innocence, there is still hope. The idea of hope relates to Blake's concept of vision continually regenerated, which means a whole adult - a combination of innocence and experience - is still possible in the nurse.

Bronowski points out that in the poems such as *The Chimney Sweeper* and the *Nurse's Song* there is the ingredient of the child growing in conflict with parents and authority. There is resemblance here to Sigmund Freud's concept of the child in opposition to and murdering the father in the Oedipal situation in order to become an adult.
3.7 The Auguries of Innocence.

Blake was a prodigious writer. Bronowski notes "Blake wrote almost a quarter of a million words in his prophetic books. They were not always careful or polished words; he wrote them as they came to him, and he did not always go back today over what he had written yesterday ... "(Bronowski, 1958, p11).

Bronowski captures Blake's spirit of energy, and devotion to his social and personal causes, when he says of him: "The subject is the distortion of man by the rigid frame of the law and society and the conventional systems. The subject is war, tyranny, and poverty; the triumph is human freedom" (Bronowski, 1958, pp11 - 12). These comments of Bronowski are startlingly like his own passion: "I beseech you in the bowels of Christ, think it possible you may be mistaken" (Bronowski, 1973, p 374), referring to the tyranny of the Nazi authoritarianism. It is also akin to Maslow's thought that in human history man has always been sold short in being accorded respect and opportunity for the expression of his own individual self. Just as I believe this, it is also one of Maslow's fundamental beliefs, which he recorded on p 7 in his 1971 study.

To show another facet of Blake's sensitivity to the timely and the timeless struggle against authority's attempt to injure the dignity and the worth of people and animals, he wrote one hundred and thirty lines, often in couplets, which form the Auguries of Innocence, written about 1803. When these are read straight through, the Auguries have a powerful rhythmic flow.

For the purposes of illustrating Blake's dialectic of progression from innocence to experience, from innocence to the adult hypocrite, I have selected some examples of the Auguries, with a particular reference.

To begin there are the four lines of inspiring, universal themes which have already been used to support Einstein's sense of the mystery and awe, associated with human perception of Nature.

To see a World in a Grain of Sand 
And a Heaven in a Wild Flower 
Hold Infinity in the palm of your hand, 
And Eternity in an Hour
I was reminded of the power of these words, with their sense of the mysterious, and their dignity, when on a sunny winter afternoon in August 1997, I stood on a path at the Gooseberry Hill National Park. I looked down the valley at the densely packed array of trees, shrubs, grass-trees, and wildflowers, all glittering in the sun. There were occasional bird calls. It was so peaceful. I was suddenly aware, as I felt myself relaxing, before the 'crowds' of Nature, that the Environment of Nature has its own dignity and purpose. I felt privileged to be allowed to look on this diverse healthy life of Nature. This is what I understood by the lines at the beginning of the Auguries.

My reaction was a "peak experience" as Maslow describes heightened awareness, or as Maslow himself put it: "an illumination, a revelation, an insight" (Maslow, 1971, p169).

This peak experience which I described is one of the ingredients which Bronowski refers to as a priori reactions to great poetry, and enters into the universal, absolute, root passions of the poetic mind. These expressions were discussed in the previous chapter. There is further discussion of this theme in poetry in particular and the humanities generally together with the activities of natural science in later chapters, which will deal with Bronowski's belief in the communality of the creative imagination generating knowledge.

The Auguries cover topics as diverse as the uncaring power of authority in various guises - such as the callous individual - State power in its various forms - as well as the hard side of the hypocrite (the adult) and the exploitative capacities of the industrialists of the time over the simple, the unsuspecting, the poor, and the innocent ones.

The Oxford English dictionary defines "auguries" as: "the practice of divining from the flight of birds" so it is appropriate that Blake begins the consequences of restrictive practices in his Auguries of Innocence by using birds as examples.

* * *

A Robin Red Breast in a cage
Puts all Heaven in a Rage

A dovehouse filled with doves and pigeons
Shudders Hell through all its regions

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and a potent political observation:

    A dog starved at his Master's Gate
    Predicts the ruin of the State

especially when the State is poisoned by a dictator:

    The Strongest Poison ever known
    Came from Caesar's Laurel Crown

and

    Naught can deform the Human Race
    Like to the Armour's iron brace

As well, Blake deals poignantly with the plight of ill-used animals:

    A Horse misus'd upon the Road
    Calls to Heaven for Human Blood
    Each outcry of the Hunted Hare
    A fibre from the Brain does tear.
    A Skylark wounded in the Wing
    A Cherubim does cease to sing.
    The Game Cock clipp'd and arm'd for fight
    Does the Rising Sun affright.

Blake demands strong redress for animal mutilation, and implicit in his concern for animal welfare is his concern for human wellbeing. An interesting contrast to the revenge sought for insulting the Hare, the Skylark and the Game Cock, is this delicate augury which carries great force:

    He who shall hurt the little Wren
    Shall never be belov'd by Men

with the ultimate punishment, an outcast from humankind.

Blake compounds the issue of mutilation and the reader's sympathies for the animals when he includes the couplet:

    The Lamb misus'd breeds Public strife
    And yet forgives the Butcher's knife

which is relevant today in the continuing ethical arguments about the use of animals for human consumption and the protests of the animal welfare lobby.
about the transport of live sheep in sheep carriers to the Middle East - another instance of timelessness in Blake’s work.

Another set of auguries related more directly to humans, demonstrating Blake’s philosophy of life linked to the progression of innocence and experience is:

A Truth that's told with bad intent
Beats all the lies you can invent.
   It is right it should be so;
Man was made for Joy and Woe;
   And when this we rightly know
Thro' the World we safely go.
Joy and Woe are woven fine,
A Clothing for the Soul divine;
   Under every grief and pine
Runs a joy with silken twine

and referring to the beginning of life in the Infant and the Child Blake writes:

   He who mocks the Infant's Faith
Shall be mock'd in Age and Death
   He who shall teach the Child to Doubt
The rotting Grave shall ne'er get out.
   He who respects the Infant's faith
Triumphs over Hell and Death

(Blake, in Bronowski, 1958, pp 67 - 70).

So, despite these dire predictions in the Auguries, there remains hope. There is always the hope of dissent, meaning vision, vision thwarted and vision again, which is part of the human being. In Blake’s lifetime the hope had to be maintained against the way the Whigs used the cleric Richard Bentley to systematize the regularity of the planetary orbits professed by Newton to regulate and order the lives of the general public. Later there was the spiritual and material mutilation of the same general public by the censorious Tory politics and George III. Underlying all these forces are the demoralizing and dehumanizing power that could be wielded by the manufacturing dissenters of the mills and looms and mines: women and children working incredibly long hours, and men who had been cottage craftsmen and weavers reduced to a pair of hands.
But there is always hope in Blake's lines:

_He who respects the Infant's faith_
_Triumphs over Hell and Death_

(Blake, in Bronowski, 1958, p70).

At this point, Bronowski's study of Blake comes full circle, with Blake's interpretation of the dissenting Puritan Unitarian gospel written by the poet about 1818: the _Everlasting Gospel_. Two of the lines from this long poem are:

_Mutual Forgiveness of Each Vice,_
_And oped the Gates of Paradise_

(Blake, in Bronowski, 1958, p74).

The circle is complete with the last chapter in both the 1958 and 1972 editions of Bronowski's work. The chapter is titled _The Man without a Mask_. Bronowski discusses with a sincerity which shows his passions, beliefs and values, what he means by great poets, in particular Blake, offering universal absolute and direct experience of life.

Bronowski says "Men who are denied the right to dissent are no longer full men, they do not make a society worthy of man: they seem to me to be something else besides Human Life: the right to ask, and to be answered, truth; the right to judge and to choose, dignity; these, and justice, and pity, and love, and reason, are the shape of man's mind. These drive him to shape as a shadow the societies in which he must try and will fail to fulfil himself. Their dissent gives him the hope, their dissent alone gives him the power to fail by less" (Bronowski, 1958, p 204; Bronowski 1972, p189).

With his style "as reasoned as geometry" from _The Poet's Defence_, Bronowski goes on to discuss the unchanging shape or cast (as Bronowski likes that word) of mind. His style can be set alongside the existential concept which I have referred to in the course of this chapter. For Blake, the Human Form Divine is "the soul which is lasting and common in men ... Blake looked for man's fulfilment in that which at last makes him man alone, and alone makes him man. The sum of his mind, his feelings, his dignity, his knowledge of truth and of love, his reason in the widest meaning, his belief in his own imagination.
The imagination set the worth for which societies reach and fail: pity and justice, order and happiness, peace and passion" (Bronowski, 1958, p197).

Now here Bronowski is surely moving towards defining through Blake, the absolute, universal, direct experience which is akin to the experience which Abraham Maslow describes as creative behaviour. But Bronowski is not yet satisfied. He questions whether Blake "could ... believe truly" that these qualities of the Human Form Divine "are held in common by every man, of very clime and time" (Bronowski, 1958, p 198). Bronowski is sceptical because societies change, there are "glacier-slow" movements of nature that change and that just as man will outgrow "the ideals of Plato and the innocence of Blake" so what is absolute, universal and direct? Bronowski's words are "What truth can be stable in the soul of man, so easily mutilated by nature so changeable?" (Bronowski, 1958, p198). Blake's language, his spelling, his rhymes, his words, his style of etchings predate our knowledge of quantum physics, his understanding of Isaac Newton was naive. What is unchanging is the Human Form Divine. Bronowski says "... across all societies, man speaks for himself in his own image ... Man who sees and thinks in three dimensions, whose reasoning is grounded on true and false alone, who feels loneliness, love and pity as passions, is fixed to a shape of mind which is absolute for his kind" (Bronowski, 1958 p199).

These words of Bronowski echo back to a poem of Sir Philip Sidney:

My true love hath my hart and I have his

This is the universal bonding of man and woman, of adult and child, of humans to nature. Here, I am reminded of my own experience of feeling akin to nature, when I stood and gazed about me in the Gooseberry Hill National Park.

Can the absolute, universal be put better than these words from Blake, selected by Bronowski: "Blake saw that man as one, and saw 'the timelessness of the instincts' as a more moving force towards truth" (Bronowski, 1958, p200).

Blake wrote; "The truth and certainty of Virtue and Honesty, ie, Inspiration, needs no-one to prove it; it is evident as the Sun and the Moon. He who stands
doubting of what he intends whether it is Virtuous or Vicious, knows not what Virtue means. No man can do a Vicious action and think it to be Virtuous. No man can take darkness for light" (Blake, in Bronowski, 1958, p200).

This proclamation is surely Blake's root passion of the Divine Image. Ethically it relates to Sidney's Virtue and erected wit, Dryden's root Passion of Nature, and the root passion of Wordsworth although in the case of Wordsworth, pleasure is the root passion. Again, what comes to mind here is Abraham Maslow's reference to the bearded old gentleman feeling pity for the jeering Berlin crowd, expressing the concept of Transcendence. Viktor Frankl's (1905 - 1997) survival during his incarceration at Auschwitz during the Nazi regime, by finding meaning within himself, (reported in his obituary notice in The Australian) is another instance of Virtuous behaviour in the sense that Sidney uses the expression. Blake would understand, and I have come to recognize, this as universal and absolute direct experience.

Bronowski himself looks at Blake's thought in yet another way, by calling on the "orthodox materialist Christopher Caudwell who has said: 'Great art which performs a wide and deep feat of integration - has something universal, something timeless and enduring from age to age. This timelessness we now see to be the timelessness of the instincts, the unchanging secret face of the genotype, which persists beneath all the rich superstructure of civilisation" (Bronowski, 1958, p199).

Blake's root passion, the "Human Form Divine", Christopher Caudwell's reference to the "unchanging secret face of the genotype", my own references to Abraham Maslow's Being Cognition, and the human capacity for Transcendence as in the old Jewish man, all surely confirm Bronowski's belief that great poets, and all great humanists, provide universal, absolute, direct experience. As the thesis progresses into new areas, these thoughts will be integrated with Bronowski's understanding of the creative attitude in science as well in the humanities. My study of Niels Bohr is an attempt to illustrate transcendence and creativity in science. (Sarfaty, 1993).
Towards the end of his 1958 and 1972 editions of Blake, Bronowski discusses poetry and propaganda. He says "poems move men in society" - (for me WB Yeats poem 'An Irish Airman Foresees his Death,' is an example of this) - "as well as man alone. For their language moves, as well as that which it says. And since the tasks of language are social, societies have looked askance where they have seen it most moving. Watchfully, they have asked, How far is the end of poems that of all language, to get things changed? When does literature make propaganda?" (Bronowski, 1958, p200).

Bronowski answers by considering propaganda first: he says "Propaganda has for its aim the changing of society to serve one interest in place of another. Those whose interest is to be served seldom need propaganda to tell them so. Propaganda must make the new society comfortable to men who have least to gain. And the proselytizing religions, and the doctrinaire parties, use writers who plan precisely for each set of hearers" (Bronowski, 1958, p200). Certainly Bronowski allows "writers of literature have their own vested interests. Whether they wish it or not they write propaganda for it. And this is why societies have feared them. The fear seems odd to us: literature has few readers and what it says to them does not seem urgent. What is its propaganda? What led (Prime Minister) Pitt to fear such men as Blake? ... Pitt wished to silence Blake and his fellows, because they were Radicals in a Tory society. This answer is too plainly true to be new. Nevertheless it has been better understood by the designers of states than the writers of literature" (Bronowski, 1958 p201).

Coming up to the twentieth century, Bronowski said "For this is as much why Hitler exiled men trained in science" (and the arts too, viz Bruno Walter and Thomas Mann) "from his state, as why Plato exiled poets from his. Mein Kampf gives this reason more roundly true than The Republic" (of Plato). "The object of propaganda is to compel the whole people to accept a doctrine. 'Our organization only admits into its ranks those whose psychological make-up is such that they do not threaten to become an obstacle to the further spread of our idea' (Hitler)" (Bronowski, 1958, pp201 - 202).
This extended quotation from Bronowski's last chapter of his Blake studies highlights the value and importance of the dissenters in advancing society and its inhabitants in the continual struggle of vision and vision thwarted, in the progression from innocence to hypocrite and back again, to use Blake's terms.

To complete Bronowski's passion on this topic, he quotes again selections from Plato and Hitler about their attitude to dissent:

"If you want to run a state for ever without trouble, says Plato, says Hitler (and his Reich of a 1000 years), get rid of those whose make-up is odd, questioning, dissenting. Get rid of truth, get rid of literature, because their common interest is dissent" (Bronowski, 1958, p202). Dissent in various forms in science and human values, science and ethical responsibility, and science and the arts in society, are a foundation belief in Bronowski's lifelong pursuit.

Bronowski adds these lines from Songs of Experience, 1794:

\textit{Introduction:}

\begin{quote}
Here the voice of the Bard:  
Who Present, Past and Future, sees;  
Whose ears have heard  
The Holy Word  
That walk'd among the ancient trees,  

Calling the lapsed Soul,  
And weeping in the evening dew;  
That might controll  
The starry pole,  
And fallen, fallen light renew!

'O Earth, O Earth return!
\end{quote}

(Blake, in Bronowski, 1958, p41).

As Bronowski said "No-one who has seen Arkwright's mills still standing, large and gloomy, among the lonely Derbyshire hills, whose beauty was another of Blake's unseen visions, will doubt the pity, the truth, and the urgency of his faith" (Bronowski, 1972, p177). With these words, Bronowski goes to the heart of William Blake, and surely must touch the heart of his reader.
Dissenters are still needed to help create a good society against today's greenhouse gas emissions, the ozone hole, smog, the destruction of forests and the habitats of animals. The dissenters who need to deal with the still present fear of nuclear war, of the social and ethical problems of genetic engineering, and the social and political restrictions on people in nations in various parts of the world may feel hope at Blake's call "O Earth, O Earth return".

Bronowski concludes his work on *A Man without a Mask*, a term in both his 1958 and 1972 editions, by recording how "nearly thirty years after Blake's death, the painter Samuel Palmer recalled him 'his aim simple, his path straightforward, and his wants few; so he was free, noble, and happy'. He put the memory of Blake into one phrase -

He was a man without a mask.

I can add nothing to this epitaph" (Bronowski, 1958, p 208, 1972, p 193).

Of himself and the acceptance of his works on Blake, Bronowski wrote in the 1972 edition "When I wrote my book in 1942, Blake was regarded as an untaught and remote mystic whose poems lay quite outside his times and our tradition. I showed, in his life and in his writings, that his inspiration was both more robust and more universal than this, and that his vision never missed the meaning of the tremendous years through which he lived. Since my book was first printed, this more ample view of Blake has begun to enter the textbooks, sometimes with and sometimes without acknowledgement. More important, the researches of others have brought new evidence of Blake's informed, exact, and apt interest in his whole world" (Bronowski, 1972, p17).

To sum up, the chapter ranges through the work of both William Blake and Jacob Bronowski. Both men lived with visions, Blake's mystical, Bronowski's that of a public educator concerned to promote ethical behaviour in society. Both valued dissent, and both sought the truth of experience in themselves and others.

The essence of the chapter is Blake's philosophy of self fulfilment - vision and then vision thwarted, or put in other words - the dialectic between innocence and experience as the qualities of a whole adult. The chapter contrasts Blake's
poetry and prophetic books, the Songs of Innocence and the Songs of Experience, the Auguries of Innocence set against the struggle of ordinary men, women, and children to be themselves, with respect and regard for themselves as humans.

Always in the background is the turmoil of the Industrial Revolution initiated by independent, self-educated men of whom Blake himself was one, and the political exploitation of them by the mercantile Whigs, and the landed aristocratic Tories, asserting themselves at the expense of the ordinary people.

I have used the title From Peterloo to Belsen to cover the history of Blake's time right up to Bronowski's own era. What is so important is that both men maintained an optimism; Blake that visions could be regenerated; Bronowski that optimism for man's Ascent in cultural development generates from our unique human specificity.

Figure 3.16 Jill Ker Conway

For myself, who set out to write about Jacob Bronowski as a public educator in science and the arts, these three chapters of the thesis to this point have been a personal experience, a "peak experience" as Maslow would say. Certainly I have drawn on my background in clinical psychology to help me structure the three chapters, and I wanted to write these lines because I came to recognize instantly a paragraph from Jill Ker Conway's autobiography True North, as applicable to myself. During the 1970's, Conway was at Harvard University
pursuing studies about American women who were politically active, and Conway wrote of her PhD history supervisor, Donald Fleming, "One's research should always involve an element of therapy'. He said smiling. 'It only counts if it is really close to the bone'.

Reading the various poets, especially Blake and Wordsworth and Yeats, rereading after some years Abraham Maslow, to whom I have always felt close, and then going on to an awareness of Bronowski, has been personal therapy for me. I hope this will continue.
Chapter 4: Bronowski Develops His Epistemology.

"We are suspended in language"

Niels Bohr (1885-1962). Danish Quantum Physicist.

As the true method of knowledge is experiment, the true faculty of knowing must be the faculty which experiences. This faculty I treat of.


4.1 Optimism in Bronowski’s belief that humans desire the good society.

When I originally planned this thesis in 1996, chapter 4 was to be an examination of Bronowski’s ‘constructivist philosophy’ through his writings on knowledge and imagination, language and the emphases Bronowski places on the arts (literature, particularly poetry, visual and plastic) and science, as languages. The books to be used were Science and Human Values, The Identity of Man and The Origins of Knowledge and Imagination. The last book is the subject of the next chapter, chapter 5.

Because of my experience, in writing the first three chapters covering the period up to 1999, my plan for this chapter, while still dealing with epistemology, has widened considerably. I set the foundations of the topic by using Bronowski’s own account of the destruction of the foundations of Nagasaki in 1945 by the atomic bombing of that city and seaport.

In a small volume Science and Human Values written in 1958, and then published widely in 1961, Bronowski began with an account of his arrival at Nagasaki in 1945. At that time he was Scientific Deputy to the British Chiefs of Staff Mission to Japan. Here in his own words, powerfully written because of a powerful, indeed personally shattering experience is what he said.

“On a fine November day in 1945, late in the afternoon, I was landed on an airstrip in southern Japan. From there a jeep was to take me over the mountains to join a ship which lay in Nagasaki Harbour. I knew nothing of the country or the distance which lay before us. We drove off, dusk fell, the road rose and fell away, the pine woods
came down to the road, straggled on and opened again. I did not know that we had left the open country until unexpectedly I heard the ship's loudspeaker broadcasting dance music. Then suddenly I was aware we were at the centre of damage in Nagasaki. The shadows behind me were skeletons of the Mitsubishi factory building, pushed backwards and sideways as if by a giant hand. What I had thought to be broken rocks was a concrete power house with its roof pushed in. I could not make out the outline of two crumpled gasometers; there was a cold furnace festooned with service pipes; otherwise nothing but cockeyed telegraph poles, and loops of wire in a bare waste of ashes. I had blundered in to this desolate landscape as instantly as one might wake among the craters of the moon. The moment of recognition when I realized I was already in Nagasaki is as present to me as I write, as vividly as when I lived it.” (my emphasis) “I see the warm night and the meaningless shapes; I can even remember the tune that was coming from the ship. It was a dance tune which had been popular in 1945 and it was called Is You Is Or Is You Ain't (Ma' Baby)” (Bronowski; 1961, p13).

Bronowski continues: “This book which I have called *Science and Human Values* was born at that moment. For the moment I recalled was a universal moment.” Bronowski's profoundly felt response would transcend his ordinary everyday experiences, and link him to those people who experience B-Cognition responses, be they scientists, poets or other people, who open themselves out to experiences beyond the everyday. Maslow cites David Suzuki on characterizing B-Cognition as "living in the light of eternity." (Maslow; 1971, p241). William Blake's introduction to the *Auguries of Innocence* which I discussed in chapter 3, beautifully characterizes B (Being)-Cognition:

*To see the world in a grain of sand*  
*To see heaven in a wild flower*  
*To hold Infinity in the palm of your hand*  
*And Eternity in an Hour.*
Figure 4.1 Sheet Music for “Is You Is, Or Is You Ain’t (Ma’ Baby)”
I would like to give my memory of how my own imagination was aroused in 1945. Together with many other members of the AIF, early in 1945, I had participated in a landing on Labuan Island off the coast of North Borneo. Many of the Japanese Imperial Army had fled the Allied invasion, or had been killed by Dyak natives. I saw many Japanese soldiers dead from gunshot wounds presumably from the Dyaks. But relating more to Bronowski's experiences is my memory of the morning of 6th August, 1945. I was attached to an anti-aircraft battery, as a radar mechanic and that morning, at 11am a statement circulated round the camp. At first it was treated as just another rumor: ‘An atom bomb has been dropped on Hiroshima.’ Not long after came another incredulous statement; Nagasaki had been destroyed by an atom bomb and the Pacific war was over! VJ Day, victory in the Pacific over the Japanese had been achieved. All the phrases of the time still linger in me. Each one of us in the camp had had his imagination dwarfed, somewhat akin to Bronowski, who described his sense of being dwarfed when he said, “We looked up and saw the power of which we had been proud loom over us like the ruins of Nagasaki.” (Bronowski; 1961, p18).

One pointer to the direction Bronowski's life was to take, specifically the study of 'human specificity' at the Salk Institute is indicated when he wrote; “The power of science for good and/or evil has troubled other minds than ours. We are not here fumbling with a new dilemma; our subject and our fears are as old as the tool making civilization.” (Bronowski, 1961, p14).

Bronowski continued his grim words and his description of the English language as 'boney' is appropriate when he says, “Men have been killed with weapons before now: what happened at Nagasaki was only more massive (for 40,000 were killed by a flash which lasted seconds) and more ironical (for the bomb exploded over the main Christian community in Japan).” (Bronowski, 1961, p14). He concluded “And civilization asks of both ruins Is You Is Or Is You Ain't (Ma’ Baby?)”

Nicholas Humphrey in his 1981 Bronowski Memorial lecture has given strong support to Bronowski's appeal, as to who is responsible, when he says,
“140,000 were killed at Hiroshima
70,000 were killed at Nagasaki
6,000,000 were killed in the Holocaust.”
(NB 40,000 were killed in the flash but 70,000 were killed altogether at Nagasaki. Humphrey also notes that 6,000,000 were killed at Auschwitz).

As to atomic weapons, Humphrey adds imaginative power to the figures, by saying that atomic destruction was wrought by “25 pounds of uranium the size of a cricket ball.” He warns that the sense of “incomprehension” about the size of the loss of life and the sense of “helplessness and denial” by the public leads to “impotence” in the community, and he warns against the failure by the public to protest against politicians who accepted nuclear armament (Humphrey, 1982). The politicians who authorized the use of the atomic bombs were US President Truman and the British Prime Minister Churchill. It was Himler of the Nazis who described the loss at Auschwitz as “special treatment” referring to the Jews.

This discussion relates to Bronowski's conception of epistemology which follows.

For the present considerations, it is it is important to say that what is alarming about the warnings on responsibility, is that the issues relate to the question “who shows a sense of love and caring for ‘Ma' Baby’, in the song Is You Is Or Is You Ain't (Ma' Baby.)”

William Blake in his prophetic books showed a sense of love and caring. The prophetic book Vala or the Four Zoas not only described the crucial aspects of the Industrial Revolution on the ordinary populace of his time, but the visionary qualities of Blake allowed him to see ahead to events of the twentieth century, to what Bronowski called the two catastrophes, the rise of Nazism and the atomic war on Japan. Blake wrote:

\[
Vala's Lament.
\]

\[
O\ Lord\ wilt\ thou\ not\ look\ upon\ our\ sore\ afflictions\\
Among\ these\ places\ incessant\ labouring,\ our\ hard\ masters\ laugh\\
At\ all\ our\ sorrows.\ We\ are\ made\ to\ turn\ the\ wheel\ for\ water\\
To\ carry\ the\ heavy\ basket\ on\ our\ scorched\ shoulders\ to\ sift\\
The\ sand\ and\ ashes\ and\ to\ mine\ the\ clay\ with\ tears\ and\ repentance\\
I\ see\ not\ Luvah\ as\ of\ old\ I\ only\ see\ his\ feet\\
Like\ pillars\ of\ fire\ traveling\ thro\ darkness\ and\ now\ entity
\]
The times are now returned upon us we have given ourselves
To scorn and now are scorned by the slaves of our enemies
Our beauty is covered over with clay and ashes and our backs
Furrowed with whips, and our flesh bruised with the heavy basket
Forgive us O thou piteous one whom we have offended, forgive
The weak remaining shadow of Vala that returns in sorrow to thee.

(Blake; 1993, p78).

William Blake’s visionary quality, from the Industrial Revolution on to the
Scientific Revolutionary Age is borne out by the Lament of Vala. Bronowski,
always a man of optimism about the capacity of humans to generate socially good
societies did not descend into guilt when he saw Nagasaki, but the shock did alter
the direction of his life interests. This is important to recognize in order to
understand his epistemology.

Figure 4.2 Photograph of Hiroshima shows the extent of the destruction which must have been
similar to Nagasaki.

4.2 Science and human values.

Bronowski’s generosity of spirit and belief in the ethics of science was evident
when in 1953, he accepted an invitation as visiting Carnegie Professor to lecture
at the Massachusetts Institute of Technology. The lectures became the basis of the volume *Science and Human Values*.

Three lectures titled *The Creative Mind*, *The Habit of Truth* and *The Sense of Human Dignity* are topics taken up again in *The Identity of Man* and *The Origins of Knowledge and Imagination* but *Science and Human Values* will be considered now, since I consider them Bronowski's immediate response to the song *Is You Is Or Is You Ain't (Ma' Baby)*?

*The Creative Mind* offers an account of Bronowski's epistemology, and is an activity common to both science and the humanities/arts, and although in science it generated the atomic bomb, scientists argue Bronowski are not white-coated, bespectacled men who impassively push buttons. The creative act of the mind, whether in science or the humanities, looks to bring seemingly unalike facets of nature or unalike personal experiences together to integrate the likeness. Bronowski is fond of using Isaac Newton's metaphor of the ball thrown to the horizon, and then circling the earth, or the well-known apple falling to the ground, and relating these situations to the orbit of the moon, through gravitational forces eventually producing the formula

$$F = \frac{G m_1 m_2}{d^2}$$

the law of universal gravitation.

1. The traditional image of Newton watching the apple fall. For over three centuries this has been perceived as the moment of inspiration for the theory of gravity, but the story was almost certainly fabricated by Newton to disguise the truth.

*Figure 4.3 Newton watching the apple fall.*
Leonardo da Vinci, one of Bronowski's heroes, painted *The Lady with an Ermine* to show how the anatomical structures of the face of the lady and the face of the stoat were alike.

![Leonardo da Vinci “Lady with an Ermine” Czartoryski Museum, Cracow](image)

Figure 4.4 Leonardo da Vinci “Lady with an Ermine” Czartoryski Museum, Cracow

Likeness from the seemingly unlike is the foundation of Bronowski's epistemology. The act of creation by one person, achieving alikeness, is received by the creative art of interpretation by another. Both people are open to experience, and therefore responsive to the human endeavors for making knowledge. They are not, insensitive to the humane act of creation, at its highest, the Maslovian B-Cognition. This is a belief of Bronowski which underlines his discussion of poetry where both poet and reader are united in this sensitivity to the poets' endeavours. Later in this chapter I provide examples from three poets, Philip Sidney, Samuel Taylor Coleridge and William Wordsworth, where their works are valued by me because they touch me personally. Niels Bohr often remarked that the act of creation by one person and the act of interpretation by another was the actor-spectator situation.

Frank Barron, the American psychologist, was especially interested in personal freedom and creativity and he quotes E. Paul Torrance’s delightful and insightful characterization of the creative individual. Torrance wrote:
"The creative individual needs to recognize and esteem his own creativity; he needs to learn how to guard it from exploitation and abuse; he needs to know how to accept inevitable limitations in the environment while yet holding to his purposes and searching for opportunities for the expression of his talent. He also needs to learn how to cope with hardships and failure, with anxieties and fears, and to avoid isolation and retreat; he perhaps needs to learn not to be more obnoxious than necessary. He must not in his own mind equate rebellion with delinquency, or be led from rebellion to senseless and categorical opposition to society; he must resist the idea that his divergence is a sign that he is mentally ill or a bad person; he must be able to integrate the masculine and the feminine in his nature and not sacrifice part of himself to the social stereotype of masculinity or femininity." (Barron; 1969, pp128-129).

So far as science is concerned and the humanities/arts too, genuinely concerned people are involved, they are not the impersonal person whom many of the public imagine. Bronowski considers where the "shame", to use his word, lies for such events as atomic bombing, and this will be discussed further on.

Bronowski's characterization of knowledge in science and the humanities can surely only be generated by concerned people and in his account of the creative person Bronowski concludes that science is defined "as the organization of our knowledge in such a way that it commands more of the hidden potential of nature" (Bronowski; 1961, p18). Torrance's qualities must be involved.

In his second MIT lecture The Habit of Truth Bronowski asserts that our understanding of nature and of inner experience follows the patterns of:

(i) seeing or hearing what is there
(ii) joining or integrating the parts
(iii) then the uniquely human capacity to symbolize the object - a face, a coin, a cup so that it can be considered when it is not actually present
(iv) then in scientific knowledge constructing theories and then laws

In his third lecture, Sense of Dignity Bronowski states that in the 400 years of its existence, the emphasis in science, has been not on ends, but on the means of understanding and knowing. The emphasis is on respect for the person as well as epistemology. Until recently more likely the person is a man, now often women,
who discovered and welded unalike events into likeness. It is the process of exploring within the person of the scientist, which demonstrates qualities of originality, independence and dissent. These qualities relate to Torrance, they are fundamental to Bronowski himself, and his scientific colleagues, and they give dignity to the scientist. This is not just empty flattery. It is important in considering science as an ethical authority. (Bronowski; 1961, p70).

While Bronowski acknowledges some individual men who practice science can be "grave, socially quiet, awkward" (Bronowski; 1961, p68), there is respect for both the act of creation and for scientific activity which at its best is a democratic society. This quality, Bronowski says he was aware of as an undergraduate at Cambridge when he saw young and old men questing and questioning. (Bronowski; 1939, viii). Of course, there can be some dissonance amongst scientists, which suggests that Bronowski's perceptions of those times had a naivety associated with a young man, although Robert Reid's comments, which I mentioned in chapter 1, certainly confirmed the question of quality in Bronowski, and the dissonance was displayed by some members of the academic establishment objected to Bronowski's appointment by the BBC to create The Ascent of Man.

On a wider social scale, Bronowski makes an interesting and original observation relating the questing interest of science to everyday life, when he says, “Today we find it as natural to prize originality in a child's drawing and an arrangement of flowers as an invention. Science has bred a love of originality and work of independence.” (Bronowski; 1969, p70). This seemingly innocent connection between a child's drawing or a vase of flowers and scientific endeavor has so much originality itself. It also indicates the basis of scientific epistemology originating in sense impressions of what we see. It relates science to everyday life, brings it into the home or play centre, and again emphasizes the inappropriateness of regarding the scientist as the impersonal, white-coated, bespectacled man pushing buttons. It also relates to Torrance's broad view of the creative person being a person in society. The reference to the child's drawing or the flower arrangement helps bring scientific knowledge generated from our science impressions, as perceived as special and elite into the "public mind". This term Bronowski uses in his later studies and reference will be made later.
Going back to the question asked by the song *Is You Is Or Is You Ain't (Ma' Baby)* Bronowski concludes his third lecture *The Sense of Human Dignity* by asserting,

“Science has nothing to be ashamed of even in the ruins of Nagasaki. The shame is theirs who appeal to other values than the human imaginative values which science has evolved. The shame is ours if we do not make science part of our world, intellectually as much as physically, so that we may at last hold these halves of the world together by the same values.” (Bronowski; 1961, p80).

The halves are the scientific and everyday experiences of art and the humanities. **Bronowski believes that ultimately in any society, simple or developed, that the creativity of a man is achieved by the integration of both these endeavors in the public consciousness.**

Bronowski concludes *Science and Human Values* saying,

“In a book I wrote about poetry I said: Poetry does not move us to be just or unjust in itself. It moves us to thoughts in whose light justice and injustice are seen in fearful sharpness of outline.” (Bronowski; 1939).

Ultimately as Nicholas Humphrey said, it is ourselves as everyday people aware of ourselves (the poetry influence) who have to remind the politicians of their actions. It is everyman's and everywoman's responsibility to listen to and respond to that song *Is You Is Or Is You Ain't (Ma' Baby)* because it moves us to thoughts of human responsibility in the most general way. It is a call from one person to another as to their willingness to share themselves in a relationship be it social between two people or as part of society overall.

So far, there has been a limited overt reference to epistemology and to Bronowski's epistemology, BUT epistemology underlies all kinds of knowledge and awareness from the child's drawing to the practice of science or the action of politicians. Hence the wide ranging nature of this chapter.
4.3 Bronowski joins the Salk Institute.

In chapter 1, I described how Bronowski met Jonas Salk and I wondered whether Salk had read *Science and Human Values*. I concluded that he must have been aware at least of the MIT lectures. The book also is a companion book to CP Snow's *The Scientific Revolution and the Two Cultures* (1959), and relates to Snow's argument on the division between science and literature. As Snow put it, between the "scientific luddites" and the "impoverished imagination of scientists."

Snow was referring to the literature lectures and criticasters (a term used by Bronowski in his 1966 book to describe those who analyzed poetry but never themselves produced poetry) of his day who sneered at science and scientists who took little, if any interest in poetry, paintings, and such like arts subjects. I daresay Jonas Salk must have been aware of Snow's courageous and timely views, as much as he was aware of Bronowski's beliefs.

In any event Jacob Bronowski and Jonas Salk met in 1960, and in 1964 Bronowski joined the Salk Institute. The reason why I am referring to Bronowski particularly will become apparent in the next section of the chapter. Bronowski was one of many physicists who regarded quantum physics and its revolutionary findings which so upset the confidently held static belief about the orderliness of science in the nineteenth century, as giving way to growing development in biology in the mid twentieth century. Bronowski's friend, Leo Szilard, a Hungarian physicist and a significant figure in the early history of the atomic bomb was a typical example of the men who moved away from nuclear science to biology.
Before going further into Bronowski’s epistemology as it developed at the Salk Institute, I think it appropriate to discuss the building itself, and its architect. Both are notable, each in their own way.
The architect was Louis Isadore Kahn (1901-1974), described by Heniz Ronner as “American Architect, whose building characterized by powerful, massive forms, made him one of the most discussed architects to emerge after World War II. …… the Salk Institute building has been described as ‘modern’ in style ………… stark but eloquently detailed, abstractly modern shapes combined with a formal symmetry” (Ronner; 1994-99).

When designing the building, Kahn talked with the scientists employed there, and as a result he said that

“I did not follow the dictates of the scientists who said that they were so dedicated to what they were doing that when lunch time comes all they do is clear away the test tubes from the benches and eat their lunch at those benches. I asked them was it not a strain with all those noises? And they answered: the noises of the refrigerators are terrible, the noises of the centrifuges are terrible; the trickling of the water is terrible: Everything was terrible including the noise of the air conditioning system. So I would not listen to them as to what should be done and I realizse (sic) that there should be a clear air and stainless steel area, and a rug and oak table areal (sic). From this realization form became. I separated the studies from the laboratory and placed them over gardens. The gardens became the outdoor space where they can talk. Now no-one need spend all the time in the laboratories. When one knows what to do, there is only little time one needs for doing it. It is only when one does not Know (sic) what to do that it takes so much time. And to know what to do is the secret of it all.” (Heinz Ronner; 1994-99).

![Figure 4.7 Salk Institute building facades onto a courtyard. Photo by Donald Corner and Jenny Young](image-url)
4.4 George Derfer interviews Bronowski

In 1974 in what must have been the last months of his life, Bronowski gave an interview to George Derfer, a Visiting Fellow at the Salk Institute. I want to review aspects of the Bronowski - Derfer interview now, although it is chronologically after the second book in this chapter The Identity of Man (1965). I wish to do this because the interview points up some of Bronowski's thoughts on knowledge. These thoughts will relate to the epistemology presented by Bronowski in The Identity of Man. I have a precedent for this practice. In The Poet's Defense (1939) Bronowski began with Sir Philip Sidney, an Elizabethan poet concerned with ethical conduct, and then Bronowski took Percy Bysshe Shelley, who lived centuries later, to show how poetry through Shelley, in Bronowski's view, had declined contrasted with the use of scientific ideas.

So to return to 1974, after the 1961 "Science and Human Values" study. George Derfer was Professor of Philosophy, at the University of Redlands in Southern California: “The University of Redlands lies in the heart of the city of Redlands ...... (which) has a population of 60,000 ...... ranked as one of Southern California's most livable cities ...... founded by Midwesterners seeking refuge from the cold winter months ...... the University campus is framed by mountain ranges that are home to Big Bear Lake and Lake Arrowhead ski resorts and the San Gorgonis wilderness.” (Encyclopedia Britannica 1999).

Derfer's questioning of Bronowski is focused on Bronowski's interest in linking science, poetry and human specificity. In fact Science, Poetry and Human Specificity is the title of the interview, and this allows Bronowski to link to word “knowledge”, as the key word underlying the three facets of the title. Knowledge generated by imagination, organized by rational thought gives sciences and the arts distinctly and uniquely the requirements of qualities characterizing human specificity.

Rather than give an account of the interview, I elaborate Bronowski's replies to Derfer in a general way.

When Derfer says, “You were already exploring the content of knowledge in The Poet's Defence [chapter 2 of the thesis], you were talking about the nature of
criticism.” Bronowski acknowledges Derfer replying, “it would be quite right to say that all my life I have been preoccupied with the special character of knowledge”, and he adds, “200 years ago, when Immanuel Kant (1724-1804) in Konigsberg first proposed something along these lines (the special character of knowledge) it could only be lip service to the intelligible. But now we know a great deal about the biological and functional connections of the mind” (Bronowski in Derfer, 1974; p389).

In *The Identity of Man* to come, Bronowski gives an extensive account of the biology of sensing in animals and humans, and the integrative functions of the brain that give humans their special quality of imagination. This work will give further meaning to the discussion on *The Creative Mind* in *Science and Human Values* and E. Paul Torrance's creative personality.

Bronowski tells Derfer how his experiences at Nagasaki “make me conscious of the gap that existed between the practice of science and the demands to which we allowed it to be a servant.” (Bronowski in Derfer, 1974; p389).

Bronowski uses this observation to explain that “value free (science) is a ghastly translation of the German “Wertfrei”, meaning devoid of values, unloaded by values.” This relates to Bronowski’s concern to deny the probably still popular public perception of the button pushing scientist and Nicholas Humphrey's concern about the politicians’ participation in nuclear war. He goes on to explain to Derfer “that the origins of this value free misconception go back to an “old fallacy.” Ever since Euclid formalized Greek geometry people have behaved as if science is really discovered as a set of axioms and formal propositions.” (Bronowski in Derfer, 1974; p390). This is an astute comment not only relating to the fallacy of value free science but it also explains Bronowski’s sense of brain function epistemology. Knowledge is not simply axiomatic in science. Humans generate it and so have responsibilities for it. Also he says in *The Ascent of Man*, “We have to cure ourselves of the itch for absolute knowledge and power” (Bronowski; 1973; p374). By “absolute” is meant unchanging and not subject to human responsibility.
Continuing the conversation with Derfer, Bronowski makes clear as he did in *Science and Human Values*, that “Knowledge is a creative endeavor by which we constantly keep the world afresh and make more suitable analogies using the two facets of imagination. And imagination is tied to the will to knowledge, to the belief that by knowing we are fulfilling our place in the world.” (Derfer, 1974; p393).

This is the epistemology of Bronowski who is just as much talking about his own person as the man who is driven to be a public educator.

An aspect of the work of Abraham Maslow is linked in here. Maslow wrote that the need to know is what he called “instintoid” ie, a physical hunger in humans from birth, and that on occasions it requires courage to know and on occasions there is a fear of knowing. The creative thinker has to deal with his awe, anxiety in exploring and at times his fear of plundering, so to speak, the Tree of Knowledge which can have sexual and destructive associations. Maslow wrote a paper on this topic; (Maslow; 1961).

Continuing his account of the human - specific qualities, Bronowski takes up an especially important feature: “The human animal is distinguished from others in being able to remember what is out of sight.....there must be an apparatus for the manipulation of imprints or images in the mind.....which is able to reconstruct the past from the present, must also be able to reconstruct the future.” (Bronowski in Derfer; 1974, p394). Here is the link to Maslow's work on the need to know.

Derfer now makes a significant comment to Bronowski: “In your life I have never seen you separate poetry from science as most people seem to.” (Derfer; 1974, p394). By those sorts of observations Derfer shows the continuity and consistency in Bronowski’s life thoughts. Linking poetry to science, goes back to Bronowski's days at Cambridge when he studied Mathematics and edited a literary journal *Experiment* and when he likened science as a seeing activity to the child's visual action of a painting and the arrangement of flowers.

Bronowski explains to Derfer, “his fortunate experiences of learning the German language as a boy and then English as an adolescent, and....that it made him very happy (having read Goethe and Dickens) when he read a good piece of thinking
and writing ..... Bronowski tells Derfer of his pictorial imagination which allows him to manipulate images into 'active configuration'.” (Bronowski in Derfer; 1974, pp395, 398). His wife Rita recalled, as I mentioned in chapter 1, how she was intrigued with the titles of her husband's research papers in topology.

Here Bronowski goes on to make a very important statement about poetry, which had not been said before by him in his poetry studies. He says, “Poetry is a useful topic to bear in mind when talking about scientific ideas because it reminds you that you can communicate truth in a way which carries intellectual conviction without setting up equations about it.” (Bronowski in Derfer, 1974; p396).

To me, this statement transcends the division between areas of science and areas of the arts, and it joins together our identity as humans who experience ourselves, others and nature.

Derfer goes on to ask, “how can imagination as planning of new knowledge create VALUES (sic)?” Bronowski's explanation of values includes the reference to, “The gift of foresight (which) implies that we are interested in how we should conduct ourselves in the future. But the future is not fixed and some of the possible choices that we must allow for cannot be unlearned now... we conduct our lives with the aim of satisfying not only the criteria of today and tomorrow, but those of 5, 10, 20 years time.....you must have a moral imagination” (Bronowski in Derfer, 1974; pp396-7). The reference to morals is the value response.

Derfer then turns to a new aspect. He asks Bronowski, How do you see the place of a rational ethic in your own life and work?” (Derfer, 1974; pp397-8). Bronowski does not answer directly but says “If I look back now on the forty years that have passed since then (his Cambridge years) I would say that I have been wrestling with the problem of discovering how SOCIAL responsibility arises from much deeper HUMAN responsibility. Social responsibility means responsibility to the human race, or is a collective idea to the human personality - to HUMAN SPECIFICITY ..... Man has found a home by vesting in knowledge, or what I tend now to call ‘scientific existentialism’.” (Bronowski in Derfer, 1974; pp397-8).
In his biology studies, Bronowski explains how rationality develops. Derfer and Bronowski continue the interview, but since the discussion moves to evolutionary matters, and away from epistemology. I have not gone further with Derfer’s interview.

4.5 *The Identity of Man* (1965).

It is appropriate now to consider the contents of the book of Lectures, *The Identity of Man* (1965) in this chapter. Epistemology continues as the theme and as Bronowski states it in *The Identity of Man*, "My analysis of self is an exploration of human knowledge, and these essays in *The Identity of Man* are studies in epistemology." (Bronowski, 1965; p19).

In the preface to his book, Bronowski writes, "....when I landed in New York on a lowering January day in 1964 and found waiting for me an invitation to give these lectures, I read it as an omen and a welcome...the time was here, to look beyond the argument (Bronowski refers to *Science and the Human Values*) at the whole range of the mind as one; the single identity of man.” (Bronowski, 1965, pix). The invitation came from the American Institute of Natural History, “to inaugurate its newly founded series of lectures on *Man and Nature*.” (Bronowski, 1965; pix).

There are four lectures, published as essays in this series, entitled

(i)  *A Machine or Self*

(ii)  *The Machinery of Nature*

(iii)  *Knowledge of Self*

(iv)  *The Mind in Action*

Overall the lectures cover Bronowski’s belief that humans desire to be free to be themselves, subject to some biological restrictions and that the public have a responsibility for a good society, where a good society is a social organization allowing human freedom (like the synergistic society I referred to in chapter 3). The more I ponder Bronowski’s work, the more it is apparent to me, that from his childhood years in Poland, and his interpretation of his intellectual responsibility as a Jew (which is discussed in chapter 1), the more I regard Bronowski’s Passions as a mission to try and deal with what he called the public "loss of nerve." Bronowski refers especially to the public's indifference to the ethical conduct of
scientists and the democratic structure of the scientific enterprise, over old fashioned authoritarian systems and poor ethical qualities in other areas of society. In other words, how to use our freedom and foster the qualities of Truth, Honour, Dignity and Dissent.

4.5.1 A Machine or Self.

At the beginning of Lecture 1, Bronowski says "My fundamental assumption at the outset of these essays (lectures) is that man is a part of nature, and when I say I want to be myself, I mean as the existentialist does that I want to be FREE to be myself" (Bronowski, 1965; pp2, 4) but "a self must have some consistency; its actions tomorrow must be recognizably of a piece with the actions it carried out yesterday." (Bronowski, 1965; p15). He continues, "I am not a fixed character, for I am constantly enlarged by my own experiences" (Bronowski; 1965, p17). This does not imply that Bronowski is enlarged in an ego-centric sense but more in the Maslovian older-Brotherliness way which involves responsibility, and a readiness for the self as it "turns experience into knowledge, that is into readiness for action." (Bronowski; 1965; p17). Here is a reference to Bronowski's epistemology. And at this point, he observes that "once experience is accepted, digested and stored, the machine takes over." (Bronowski, 1965; p17). So it is not a question of machines or self, but rather humans are both. When imagination generates knowledge which it incorporates into the self, then it is mechanically part of our actions.

Bronowski uses the "machine" aspect of the title in Lecture 1, to explain that the machine of human beings is not the old fashioned sewing machine which was a simple, obedient device, but rather he says, "Our new knowledge of mechanisms ...... in an age of computers means ...... a machine has an input, a process and an output, and all three of these must be mechanized ...... it is of cardinal importance here and essential to any description, that the output from the machine must be exact and unambiguous, as the input is. For a modern machine, like a man, is asked in part to regulate itself, and for this purpose it must be able to instruct itself". (Bronowski, 1965; pp19-20).
Later on, Bronowski introduces the mechanism of the sense organs and the brain and how knowledge is built up by induction of experience. I should say here that this reference to epistemology by induction is not the acquisition of knowledge by the philosophical process of induction. It is a very "species-specific" process with biological foundations, which will be explained further on in the discussion of the lectures. It is interesting to read this material which suggests Bronowski was influenced by the biologists at the Salk Institute.

Bronowski concludes the lecture saying that machines do not have imagination, whereas humans do, from which quality develops knowledge, foresight and the capacity for interpersonal relations, which shape and sharpen our responses to each other. All these features constitute epistemology to Bronowski.

The reference to sharpening our responses to each other, brings to mind Sir Philip Sidney's delicate love poem *My True Love Hath My Hart* in which the two characters in the poem share their worth and value for each other. It is an example of George Derfer's observation that Bronowski's interest in epistemology goes back to his early years and his interest in poetry, as discussed in *The Poet's Defence*.

### 4.5.2 The Machinery of Nature.

In lecture 2, *The Machinery of Nature* Bronowski expands on aspects of the biological machinery of humans such as the seeing activity connected to brain function. He relates the biology studies to the way language shapes scientific knowledge.

He begins by saying "The Traditional ideas of self are out of date because they picture the person as something given and static, and that invariably makes him a mechanism." (Bronowski; 1965, p20).

From this base line, Bronowski explains "science is knowledge of the physical working of the world ...... a rearrangement of experiences in which we put together those experiences that seem to belong together and put against those that do not." (Bronowski, 1965; p26). This is the seeking for the seemingly unlike to integrate into likeness, the creative act of the scientist. He
comments on a topic of early interest to him as a mathematician, the "geometry" of the structure of matter and he explains "when I had to measure the flash for the atomic bombs in Japan I asked why granite suddenly roughens when it gets very hot. The answer crystal structure of quartz turned out to be as practical and as beautiful in its revelations as the geometry of nature" (Bronowski; 1965, p28). He continues to a more fundamental position when he talks about the career of the carbon atom which takes part in the recycling of plant and animal life. This links Bronowski to his belief that atoms in the stars are the same as atoms in living materials. The molecules are larger in living materials but there is a continuity of structure and in the biology of living materials, "long molecules can copy themselves... and the molecules work as types of instruction in the hereditary part of the cell" (Bronowski; 1960, p29), and the tapes of instruction are the machinery of nature, like the functioning of the magnetic tapes that are used to contain the instructions for computers.

The foundation of the epistemology is the working of the human brain, Bronowski in the second lecture discusses at length the history of the eye, seeing being the medium of natural science enquiry. The eye sees nature, the ear hears poetry. The eye is no longer the old fashioned idea of a camera transmitting a series of dots to the brain. Bronowski quotes William Blake's view about the eye: "I question not my Corporeal or Vegetative Eye any more than I would Question a Window concerning a light. I look through it and not with it." And Bronowski comments: "of course Blake was wrong. Like everything he wrote, this is vigorous and visionary together, but it is mistaken."(Bronowski; 1965, p33)

In place of Blake, Bronowski enthusiastically offers a variety of studies from various neurophysiologists on the function of the eye. They include HK. Hartline (1903-1983) and George Wald and Ragnar Granit, co-prize winners of the Nobel Prize in 1967. Various animals such as frog's eyes, cat's eyes, and Horace Barlow's studies of rabbits all show that the eye transmits various shapes, contrasts of light and dark by an integrated pattern of rods and cones in the retina, and together with the human eye, what is transmitted to the brain
is "not just dots or spots of objects but an integrated aspect of what is seen in
the sense of perception." (Bronowski, 1965; p32).

Here again is the foundation of Bronowski's epistemology, and he asks,

"Now what happens as the brain receiving the partial integration of the
senses? The brain must accept less than certain knowledge and it has to have
statistical methods so that it can reach its own acceptable level of
certainty... the brain constructs a picture of the world which is less than
certain yet highly interlocked in its parts." (Bronowski, 1965; p34).

Bronowski provides a fundamental feature of his epistemology when he then
says:

"The picture [from the brain] is made by, is made of activity - It is the
implication and expression in symbolic form of all our dealings with nature.
The picture is not the look of the world but our way of looking at it: not how
the world strikes us but how we construct it" (Bronowski; 1965, p34).

This belief of Bronowski thus places an emphasis on the creative acts of the
scientist when new knowledge is forthcoming, and confirms that natural
science knowledge is human knowledge. I will discuss this feature further
later.

Bronowski's perception is reminiscent of Sir James Jeans' awareness, "The
universe begins to look more like a great thought than a great machine", and
John Wheeler's statement, "Nothing is more important about quantum physics
than this: it has destroyed the concept of the world as sitting out there. The
universe will never afterwards be the same." (Wolf; 1981, pp226, 152).

This is the link between biology, especially of the brain functions, and the
perceptions of astronomers and quantum physicists, and showing how
branches of the sciences in the twentieth century expanded out of the
expectations of certainty and fixed order characteristic of the nineteenth
century.

Bronowski moves to the next stage of his epistemology when he explains the
procedure of induction. He says,
"... we reach general statements of reasoning from the particular instances ..... about the outside world: the first step in which in science is called ...... induction. This is thought as it were a continuous conversation between the brain and its senses ......." (Bronowski; 1965, p35).

Continuing he says

"The procedure of induction by which we make rules for general categories, by which indeed we build up language of general words, is a constant to and fro between the brain and its senses...it is not possible for the brain to arrive at certain knowledge." (Bronowski; 1965, p36).

These assertions are earlier discussed in the Preface to the 1966 edition of The Poet's Defence when Bronowski compares knowledge that is open to experience on a wider basis by poets than in science. The poet is open to ambiguous knowledge because no morals are drawn in conclusion by the poet. Examples of which are given in Lecture 3. In science, there is the attempt to produce unambiguous knowledge, yet science too moves between openness and closure as the enquirer in science is trying to expand his outlook, yet closing down to create facts. Bronowski makes this distinction between poets and scientists often in many different contexts. It is such an insightful aspect of his epistemology. Bronowski could never accept the epistemology of what he calls the contemplative philosopher who is static behind his desk.

The more I read and write about Bronowski the more he comes to me as an integrated, active, involved man completely suited to the life of intellectual passion which he lived. He was an honest man in the sense of "honest" as Abraham Maslow would describe a self actualizing man. Some of the qualities I would attribute to Bronowski relative to his intellectual passion and honesty are in Maslow's words, "increased autonomy and resistance to enculturation, increased concern for problem centering," and "increased identification with the human species." (Maslow; 1968, p26). (The reader who wishes to pursue the self actualizing qualities may consult my dissertation Humanistic Psychology and Quantum Thinking (Sarfaty; 1993). I applied the thirteen qualities to the appreciation of the person of Niels Bohr.)
Bronowski goes on to analyze the structure of the language of science. It has a vocabulary, a formal grammar and a dictionary. The vocabulary consists of concepts such as gravity, neutron or neuron from physical world and the unconscious from the inner self. Grammar is the arranging of concepts in sentences such as atoms can capture neutrons or the contents of the unconscious can emerge in dreams. The dictionary translates the abstract sentences into observations, and Bronowski uses an example, Einstein's "Mass" related to "energy," $E = mc^2$. He says "I have chosen to describe science as an account of the machinery of nature, not in engineering terms, but in linguistic ones. One persuasive reason is that I shall be talking in the next essay, "Knowledge of the Self" about literature and whatever I have to say by way of likeness or contrast will be said more fairly if I used a common model." (Bronowski; 1965, p49).

In the last section of this second lecture *Machinery of Nature*, Bronowski asks "what right have we to form inductions? How do we form them?" (Bronowski; 1965, p42). He emphasizes that a law in science is not a "shorthand" for specific instances. It is not a forecast such as the famous "the sun will rise tomorrow because it has always done that." Rather more, induction "is a generalization which tries to thread its way throughout experience and to guess what has governed that." (Bronowski; 1965, p43). If this down to earth statement by Bronowski were known and understood by the general public - the "public mind" to use Bronowski's phrase, it would help reduce the mystery of science.

Bronowski calls on David Hume's (1711-1776) daring assertion in 1739, that the powers by which bodies operate are entirely unknown. (Bronowski; 1965, p44). Then as Bronowski puts it, "Induction in science is the search for, the guess at, the unattainable laws that describe these powers." (Bronowski, 1965, p44). He states his agreement with Karl Popper, twentieth century philosopher of science, who is firm in his belief that scientific discoveries are most effective, the fewer the hypotheses needed for the explanation of an event. Popper was a proponent of the falsification approach to verification of knowledge, but that issue will not be pursued further here.
Bronowski concludes the second lecture by contrasting what he describes as the ecstasy and implosive imagination which I will contrast in the next essay [Knowledge of Self] with prodigal explosive imagination of poetry. (Bronowski, 1965, p50). What colourful and powerful language to contrast poetry and science "ecstasy and implosive imagination" and "prodigal explosive imagination." The phrases brought to my mind the Coalbrookdale Bridge (Bronowski, 1974, p274), The iron bridge, constructed during the early technological phase of the Industrial Revolution, is still in existence. The grace of the bridge and its mirror image in the quiet waters of the River Severn does have a certain ecstasy. The bridge is now part of Britain's National Heritage and while vehicles are not permitted to cross the river on the bridge, pedestrians still use it. In Chapter 3, there is a picture of the bridge.

4.5.3 Knowledge of the Self

The third lecture/essay Knowledge of the Self is not a study in the psychology of the self. Bronowski uses the word "psychology" to mean a science in the way he charged the poet Percy Bysshe Shelley as a psychologist because Shelley used the expression "love thy neighbour" as a key belief in poetry. This, Bronowski discusses in The Poet's Defence (1939). I think Bronowski's view of psychology is very limited and probably never advanced beyond the psychology as science taught when he was at Cambridge. Bronowski is really much closer to the modern third force psychology of the humanist psychologists like Maslow, who worked in Bronowski's own later years. However, there is no need to pursue this further, but rather let Bronowski present Knowledge of the Self as part of this epistemology.

This third lecture is a study of knowledge of ourselves, about the ever present ambiguity of human life, its dilemmas of choice about our Being. Bronowski explains what he means by the ever present ambiguity when he says "The knowledge of self cannot be formalized because it cannot be closed, even provisionally, it is perpetually open, because the dilemma is perpetually unsolved." (Bronowski; 1965, p74).
The third lecture begins with sensory experience, in particular, a discussion of red-green colour blindness. This occurs almost always by hereditary transmissions in one in fifteen males. It is an experience of confusion in colour perception, which came to particular attention as a specific disorder in the 1770's, and in "1794 the great chemist John Dalton gave a detailed account of his own confusion of red and green." (Bronowski; 1965, p54).

From the sense dysfunction of colour blindness, Bronowski moves to drama especially Shakespeare's dramas of Macbeth and then King Lear. Macbeth and his wife the Queen were gradually hysterically disordered by the red blood stained daggers from Macbeth's murderous acts. Macbeth says,

\[ \text{Will all great Neptunes Ocean wash this blood} \\
\text{cleane from my Hand? no: this my hand will rather} \\
\text{The multitudinous seas incarnadine,} \\
\text{Making the Greene one, Red.} \]

(Bronowski; 1965, p53).

The drama of King Lear is considered, the poetry of John Dryden, 17th century English poet considered in chapter two on The Poet's Defence and William Wordsworth, 19th century English Romantic poet, with twentieth century American poets Robert Frost and John Berryman.

Bronowski's purpose is to show that in colour blindness itself or in drama or poetry there is no finiteness. As well drama and poetry allow us to cultivate an awareness of ourselves by seeing and understanding ourselves in others. This is a recurring theme in Bronowski's beliefs about poetry in particular; there is no finite, unambiguous fact like end point: Bronowski pays particular attention to Provide, Provide of Robert Frost (1874-1963).
Provide, Provide
by Robert Frost - 1936

The witch that came (the withered hag)
To wash the steps with pail and rag,
Was once the beauty Abishag,

The picture pride of Hollywood.
Too many fall from great and good
For you to doubt the likelihood.

Die early and avoid the fate.
Or if predestined to die late,
make up your mind to die in state.

Make the whole stock exchange your own!
If need be occupy a throne,
Where nobody can call you crone.

Some have relied on what they knew;
Others on being simply true.
What worked for them might work for you.

No memories of having starred
Atoned for later disregard,
Or keeps the end from being hard.

Better to go down dignified
With boughten friendship at your side
Than none at all. Provide, provide!

Figure 4.8 Robert Frost and a copy of his poem “Provide, Provide”

The imagery belongs to our own age with phrases like ‘Hollywood star’ and ‘stock exchange’ and Frost uses experiences "which we feel to bear on and have a part in our lives. People have feared and faced their decline in old age in various ways....we can avoid it by dying young ..... do not become a fallen star: provide for your survival, whatever its cost, by any means at all, however mercenary, trivial or tawdry." (Frost in Bronowski; 1965, p60).
Supporting Bronowski's study of the knowledge of the self are the two verses:

Some have relied on what they know,
Others on simply being true.
What worked for them might work for you.
No memory of having starred
Atones for later disregard,
It keeps the end from being hard

(Robert Frost)

which sets out the human dilemma with no pretence that it can be resolved by any "moralizing role!" (Bronowski; 1965, p60).

This recalls George Derfer's observation that Bronowski's interest in knowledge goes back to his early interest in poetry such as *The Poet's Defence* studies.

Bronowski uses Frost's poem to contrast the work of art (in chapter 2, there is a discussion of poetry as the essential work of art being absolute, direct and universal) with the work of science. He wrote "There are no morals in a poem; there are no morals in any work of art...[I recently heard the West Australian Symphony Orchestra perform Beethoven's Choral Symphony and it was a scintillating performance to just sit and accept it into myself.]...There are many implications in a poem which enrich our experience of life: but it is a many sided experience and we are not asked to come down on one side or the other. Robert Frost with a macabre sense of humour, pretending to teach a lesson which he does not want us to learn, epitomizes the nature of art. Here the imagination explores the alternatives of human action without ever deciding for one rather than the other. And in these tense and happy indecisions and only in this, the work of art is different from science." (Bronowski; 1965, p61). Here is a clear statement once more of Bronowski's epistemology.

The beliefs of Bronowski were so valuable to my awareness of art and science, that I was moved to recall three poems from my writings on *The Poet's Defence* in chapter 2, that have personal meaning for me, having ambiguities, but giving me meaning and satisfaction. I refer first to Sir Philip
Sidney's *O Sweet Woods*, when I gaze at the trees around me at my house in
 Gooseberry Hill:

   *O sweet woods the delights of solitarines!*
   *O how much I do like your solitarines:*
   *Where man's mind hath a freed consideration*
   *Of goodness to receive lovely direction.*

and the dilemma from the machinations of the Elizabethan court as Sidney
describes it, is pushed aside by the sweet woods:

   *Here, nor treason is bidd, veiled in innocence*
   *Nor envies snaky ey, finds any harbour here.*

   (Sidney, in Auden and Pearson, vol I).

Samuel Taylor Coleridge contrasts beauty and sadness in This Lime-Tree
Bower My Prison.

   *Well, they are gone, and here I must remain*
   *The Lime-tree bower my prison: I have lost*
   * Beauties and feelings, such as would have been*
   *Most sweet to my remembrance even when age*
   * Had dimmed mine eyes to blindness*

   (Coleridge in Auden and Pearson, vol III)

How well, I too understand the dilemma of between in his case, the lime-tree
bower, in my case the terrace of my house, when his friends go off walking in
the country leaving him, and at times I am unable to go walking in the bush
around my house with my friends, leaving me.

So too, not so much related to myself as with Coleridge and Sidney, does
William Wordsworth record the same dilemma of feeling and awareness in
*Tintern Abbey* recalling the banks of the River Wye:

*These beauteous forms*

   *Through a long absence have not been to me*
   *As is a landscape in a blind man's eye:*
   *But oft in lonely rooms, and 'mid the din*
   *Of towns and cities, I have owed to them*
   *In hours of weariness, sensations sweet*

   (Wordsworth in Auden and Pearson; vol III).
So Bronowski says, "We are not asked to come down on one side or the other. A scientific experiment is intended to lead us to a single and valued action. The experience of poetry is not....Poetry claims that it contains the very meaning of the experience of living." (Bronowski; 1965, p 62).

Bronowski comes to the point relating to knowledge of self, when he goes on to say "A poem tells us to be human by identifying ourselves with others and finding again their dilemmas in ourselves. What we learn from this is self-knowledge." (Bronowski; 1965, p63).

I consider that this is Bronowski at his best, because what he says could well be called his Principle of Tolerance. For Bronowski, "the self that we discover in this mode of knowledge is every self, and it is universal...." (Bronowski; 1965, p63). I understand Bronowski here to be referring to poetry as universal, direct and absolute experience, in the manner that he presented this belief in The Poet's Defence and I discussed in chapter 2. It links to the observation made by George Derfer, earlier in this chapter when Derfer said to Bronowski: "In your life I have never seen you separate poetry from science as most people seem to" (Derfer; 1974, p394).

In describing "poetry as universal" and the link between poetry and science, as modes of knowledge, here is another statement, made on a number of earlier occasions, of Bronowski's epistemology. I believe it is an instance of Bronowski's optimism about human worth, despite his experiences of the two catastrophes of his lifetime. In this third lecture Knowledge of the Self Bronowski continues to emphasize the two concepts of knowledge, the one in science (from the sensory activity of seeing) critical and concerned to eliminate the imagination (only after the imagination has operated as a factor in creating the knowledge!) and in poetry where he says,

"In literature there is no such resolution...we stretch the skin of isolation inside which each of us lives (despite hearing each other). But it is by no means evident that we know how to act better in any specific encounter." (Bronowski; 1965, p69).
It will be appropriate to deal further with this last sentence in the next chapter by considering a 1950 radio play by Bronowski _The Face of Violence_, where the “skin is isolation”, a most descriptive expression ...... in the dramatic .......... of the play. But now Bronowski returns to a specific poet. Since I have quoted a poem by Robert Frost, let me make the point that it is by no means evident that we know how to act better in any specific situation by quoting a harsh poem about Frost by a younger poet, John Berryman (1914-1972).

![Figure 4.9 John Berryman and His Poem "Three Around the Old Gentleman"](image)

37 Three around the Old Gentleman

His malice was a pimple down his good big face, with its sly eyes. I must be sorry
Mr Frost has left:
I like it so less I don’t understood—
he couldn’t hear or see well—all we sift —
but this is a bad story.

He had fine stories and was another man
in private; difficult, always. Courteous,
on the whole, in private.
He apologize to Henry, off & on,
for two blue slanders; which was good of him.
I don’t know how he made it.

Quickly, off stage with all but kindness, now.
I can’t say what I have in mind. Bless Frost,
any odd god around.
Gentle his shift, I decussate & command,
stoic deity. For a while here we possessed
an unusual man.
Bronowski observes about Berryman's poem:

"We might suppose that this embarrassing portrait could awake no sympathy in any of us. The faults that are imputed to Frost are not ever heroic: they are petty. Yet we should be wrong. On the contrary, the portrait is human and makes us aware that we too suffer from the same shortcomings, and have yielded to the same temptations, These vices, these very vices, are as much a part of our humanity as Robert Frost's. The poet's (Berryman) tone in the end is less cruel than ironic in teasing Frost in being neither monster nor superman, but an unusual man with the usual character." (Bronowski; 1965, pp60-61).

Bronowski goes to some lengths to draw attention to those facets of behaviour in "dramatists such as Shakespeare's portrayal of the murderous Macbeth, to the depth of John Dryden's anger as a deadly rage when he drew the famous portrait of the 1st Earl of Shaftesbury in the poem Absolom and Achitophel in 1681." (Bronowski; 1965, p71). Bronowski also asserts that we have in us the faults of Othello, Iago and Desdemona, of Dr Faustus and Madame Bovary, because "literature is not a suburban gallery of worthies." (Bronowski; 1965, p72). He reminds his readers that we have it in us to be murderers, con-men, and perverts and scum of the earth. (Bronowski; 1965, p72).

Bronowski now shows himself to be a more worldly man than the young graduate in the 1930's when he wrote The Poet's Defence in 1939. He realized by the 1960's that it is the sense of community with the wide variety of people and their circumstances that means that the experience of poetry cannot be ordered only about ethical values as the earlier proposals, nor as he said in 1965 lectures can it be formalized and put on tape. (Bronowski, 1965, p72).

Bronowski illustrated the point that there are questions which are unanswerable, and gives his epistemology its quality when he drew on John Keats and Shakespeare.

From John Keats poem La Belle Dame Sans Merci the opening line is: O what can all thee, knight-at-arms. and from The Two Gentlemen of Verona a
song which begins *Who is Silvia? What is she?* and Bronowski answers "the dilemma is perpetually unresolved". (Bronowski; 1965, p76).

A fundamental belief of Bronowski, which is also fundamental to his epistemology, is that such dilemmas can only be understood if we know what it is like to be human. This may seem, at first thought, to be a curious assertion when the lectures began with Bronowski's statement, "I want to be free to be myself" (Bronowski; 1965, p14). But it is the very nature to be free that leads to situations in daily life with other humans where dilemmas arise, and the linking of experiences comes out when "science and literature, science and art belong together as matched halves of what is unique in human experiences." (Bronowski; 1965, p78).

Bronowski finishes lecture 3 with a charming picture of a child at six months of age, whose mind, meaning memory, is like a "puppy," "Out of sight out of mind" and then as the child grows it finds a formula: "Absence makes the heart grow fonder." And then going on "memory there is foresight, so the human looks forwards and backwards" and "we can imagine nature outside ourselves into the future; we create a mode of knowledge which is science. And when we imagine ourselves alive into the future, we create another mode: knowledge of the self. They are the inseparable halves of the identity of man" (Bronowski; 1965, p80).

**4.5.4 The Mind in Action**

In his fourth and final lecture/essay *The Mind in Action* Bronowski says "I must now move away from the experimental conditions of the scientific papers and the works of art to the daily reality of human culture ... having discussed the deep but narrow culture of literature and science, I now turn to the broad culture of social life." (Bronowski; 1965, p88).

Bronowski defines "a culture (as) something that each of its members learns" and he uses examples from simple cultures (the Bantus) to modern western societies. Learned behaviour is achieved by imitation, identification and empathy. Social behaviour is also learned by understanding what other people
want because we want it too; which is related to seeing ourselves in other people. (Bronowski; 1965, p88).

Bronowski, introduces the term "kinesthesia," used as recently as 1880, which "is an inner signal that runs parallel with our own outward actions." (Bronowski; 1965, p88). Of the many examples of kinesthesia which Bronowski gives, I have selected two instances. There is a passenger in a car who presses his foot heavily to the floor when he hopes the driver is going to brake quickly.

An intriguing example is provided by the work of Wolfgang Kohler (1887-1967) reported in The Mentality of Apes. Kinesthetic reactions are seen in chimpanzees "watching in an agonized sense while one of their clumsier fellows" tries to build a tower with blocks. (Bronowski; 1965, p89).

Thus kinesthesia is a means by which a culture binds its members together in a common identity. (Bronowski; 1965, p90). It is one example of The Mind in Action. Describing a "simple society, the whole outline of a member's personality has been drawn for him like a contour on a map, when his society fixes his place." (Bronowski; 1965, p92).

This is reminiscent of the society in England which Bronowski described in his 1972 edition of William Blake and the Industrial Revolution. Before the land enclosure acts and the development of the cotton mills and the iron mills, with the associated change in society, where people had to learn to rely on their own individuality, the cottage weaver, the man in the family and others, knew their place related to God and Nature.

The development of each person's individuality has continued to the present day, and Bronowski notes that a person is "a complex of all the traits which carry him into each of the groups to which he belongs..." (Bronowski; 1965, p92). But the complexity of loyalties which the modern person has (work, family, politics, leisure, religion) relates to the failure of the two cultures of science and the arts to be integrated into a meaningful value system. This relates to Nicholas Humphrey's charge of public "impotence" to protest against the politicians who accepted (and still do) nuclear armaments
(Humphrey; 1982). What Humphrey calls public impotence, Bronowski
describes as public "loss of nerve" in the modern world. The complex of
loyalties that the modern day person has, and "we have failed so far to
knit...into one set" (Bronowski; 1965, p93), relates directly to the failure of
the two cultures of science and humanities to be integrated into modern man
and woman.

I show more of Bronowski's thought here in the next chapter where The Face
of Violence (1954) is reviewed.

Bronowski lost none of his expressive skill with the "boney" English
language as he grew older. He says, continuing the above comments, "here is
the leading edge of panic in modern man which drags his society after him. It
is his failure to make a unity of, as it were, to make head or tail of, two sets of
values." (Bronowski; 1965, p93).

As he moves towards the end of the fourth lecture, The Mind in Action,
Bronowski introduces the word truth to bind together his long held beliefs in
science and the arts, the "intimate" values of the arts as the best of knowledge
in humans.

Truth transcends loyalties. Loyalties are the conveniences of daily life,
loyalty to one's cricket team, loyalty to one's political party, whereas Truth, as
exemplified in science or the arts respects the man or woman who generates
the knowledge of nature or of ourselves, it respects the process, in science the
democratic process of enquiring and the means of enquiring, in arts especially
poetry, the integrity to see ourselves in others and to tolerate and respect
ourselves and the others. Respect, dignity of the labour of acquiring, tolerance
of the individual features of the enquirer whether scientist, poet, painter,
musician, all lift the society over the convenience of being loyal to old
fashioned, out of date ethics. Bronowski believes that until society in our
modern world believes in respect, dignity of self and of labour, tolerance of
dissent, "and dissent in turn must be protected by justice, by freedom -
freedom of thought, of speech and writing; of movement and assembly"
(Bronowski; 1965, p107) humanity will never integrate the "identity of man."
In this chapter, in the two books and interview *Science and Human Values*, *Science, Poetry and Human Specificity*, and *The Identity of Man* the theme of the creative person, the habit of truth, the dignity of enquiry, acceptances of the oddities in individuals in science or the arts as characterized by Torrance's account of the creative person - William Blake the visionary poet and the incongruities of Isaac Newton who worked in physical science and accepted mystical activities - all these concepts have been pursued in this chapter as part of Bronowski's broad encounter with epistemology.

This range of concepts is related to the sensory experiences conveyed to the biology of the brain, and by the brain's integrated action, through images to imagination, to symbolic thinking or to laws in natural science or self awareness in Bronowski's epistemology. In Bronowski's own words "...the imagination that drives these men, the greed for new experiences and the search in it for new likenesses with the old, is of a piece with that of the poets and any one of us who looks to round out his self beyond himself." (Bronowski; 1965, p104). Here Bronowski implies transcendence of the self in generating personal development beyond the daily life of the self.

He concludes lecture 4, *The Mind in Action*, and the overall account of *The Identity of Man* when he says,

"Our pride in man and nature together, in the nature of man, grows by this junction into a single source, the sense of human dignity. The ethics of science and of self are linked in this and more than all our partial loyalties it gives a place and a hope to the universal identity of man." (Bronowski; 1965, p107).

Bronowski earns respect for the broad distinctive character of his epistemology. He was a man who saw the rise of Nazism in Europe, who witnessed the devastation at Nagasaki, and who stood in the pool of ashes of those persons destroyed at Auschwitz, yet he held "hope for the universal identity of man"
Chapter 5: Bronowski Develops and Deepens His Epistemology and Associates it with Social Behaviour.

To see the world in a grain of sand
To see a heaven in a wild flower
To see Infinity in the palm of your hand
And Eternity in an hour


"At its best, reality is not only true, lawful, orderly, integrated, etc; it is also good and beautiful and lovable as well" (Abraham Maslow 1908–1970. Third Force humanist psychologist. 1971 The Farther Reaches of Human Nature. Penguin Arkana).

"Gauss (1777-1855) was particularly bitter about philosophers who claimed that they had a road to knowledge more perfect than that of observation. Of many examples I will choose one. It happens that there is a philosopher called Frederick Hegel, whom I must confess I particularly detest. In 1800 Hegel presented a thesis, if you please, proving that there could still only be philosophically seven planets ...... on 1 January 1801, punctually before the ink was dry on Hegel's dissertation, an eighth planet was discovered, the minor planet Ceres." (Jacob Bronowski 1908-1974. The Ascent of Man).

This chapter is complementary to chapter 4, and ranges as widely. The chapter has a "metaphysical" (Bronowski's term) basis in presenting the foundations of his lectures The Origins of Knowledge and Imagination. It will deal with the reality of natural and human affairs (science and the humanities), and it will be discussed in a "didactic" style to use S Luria's description, his epistemology beyond that derived from The Identity of Man (1965) in chapter 4.

In the broad plan, have I organized this chapter to parallel the plan of chapter 4. That chapter began with a discussion of Bronowski's small volume Science and Human Values, based on his MIT lectures, which started with his experiences at seeing the effects of the atomic bombing of Nagasaki. He wrote "what I met was ..... the
experience of mankind. On an evening like that evening, sometime in 1945, each of us in his own way learned that his imagination had been dwarfed." (Bronowski, 1961, p14).

5.1 Essays relevant to the play The Face of Violence

Chapter 5 begins with an equally powerful volume The Face of Violence, a slim volume, the research for which Bronowski began in 1947. The volume consists of six essays in the first section, followed in the second part by a radio play.

Bronowski deals with violence. Not the atomic violence at Hiroshima and Nagasaki, but violence as a naturally occurring human activity. Violence emerges out of humans in their relationship with each other. In particular, The Face of Violence is related to that "second catastrophe", as Bronowski categorizes it, the rise of Nazism in the twentieth century.

The passion which Bronowski displayed as he related his perceptions of Nagasaki, is paralleled by the passion with which he discusses Adolph Hitler. He describes Hitler as "Leonardo upside-down, a universal man, universally bad at everything, and I do not except either politics or war." (Bronowski, 1954, p42).

The six essays consider the meaning and expressions of violence, and at times the evil event of violence going over into vice. The time scale covered in the essays ranges from antiquity to our own day, and the titles are:

1. The Animal at City Gate
2. The Scapegoat King
3. The Beggar's Opera
4. The Detective Story
5. The Crime Story Comes True
6. The Cry to be Recognized

The second part of the volume, the radio play The Face of Violence was broadcast on the Third Programme of the BBC in 1950. It will be analysed later. Suffice to say that the play is a splendid example of the existential ambiguity in drama, considered by Bronowski in chapter 4. Overall, the volume is another example of Bronowski’s enjoyment of and versatility in using the English language, about which he spoke to George Derfer, in their 1974 conversation.
The play won the Italia Prize in 1951, for the best radio play of its year, an award shared with Rene Clair for his adaptation for the radio of Theophile Gautier's play *Une Larme du Diable*, translated as *The Devil's Tear*.

I regard Bronowski's award as testimony both to his use of the "boney" English language, but also to his own personal capacity to forgive the violence and the vice of Nazism, just as much as he absolved scientists for the destruction wrought by the atomic bombs.

A short biographical reference to Rene Clair is appropriate here. He was born in 1898 and died in 1981, and was a renowned film maker during the 1920's, '30's, and '40's. His films widely ranged from those about French topics made in France, to English films made in England, where he lived when the Germans invaded France during World War II. He also spent some time in Hollywood. Clair's play of Gautier's *The Devil's Tear* reflected Clair's range of topics. Gautier wrote many plays during the nineteenth century with religious subjects, and he, too, was well thought of in theatrical circles.

Looking through the list of prize winners of *Il Pricitalia* from 1949 to 1959, there appeared to be but one occasion when two contributors, ie. Bronowski and Clair shared the prize.

It will come as no surprise to readers of chapter 4 that Bronowski in *The Identity of Man* made two references to violence in humans. He said "literature is not a suburban gallery of worthies." He expands saying "we have it in us to be murderers, con-men, and perverts, and scum of the earth" (Bronowski, 1965, p 72). Later, when discussing and commenting on a long standing issue, current in our own society, that despite statistical evidence that the death penalty does not discourage murder, Bronowski observes "This is not because murder does not outrage their humanity, but on the contrary it throws doubt on it. They", (Bronowski means by 'they' us all at large) "catch themselves in gales of rage, the hatred of a nagging mate, and the soft urge to poison a rival and their revulsion for the murderer is also their fear of that glimpse in the dark mirror." (Bronowski, 1965, p93).
As the titles of the six essays show, he examines the violence in the ancient world of Thebes and early Greece, expressed through the animal Sphinx representing Thanatos, the destructive impulse in us all. I am reminded that Eros and Thanatos were the names given to the constructive and destructive forces in us, by Sigmund Freud. Bronowski used Thanatos to characterize the tribal upheavals and ceremonials against the sins of authority, the scapegoat kings. In our own recent times, that is, at the end of the World War II Mussolini was executed and hung upside-down as the price for his "kingship."

![Image](image_url)

*Fig 5.1 Mussolini (R Bosworth, Unilview)*

In his essays, Bronowski makes clear that those in power, even in so called "civilized" societies, commit sins of authority. Both essays 5 and 6 in particular will consider this.

As well as references to early tribal societies and outbreaks of violence in modern day societies, the essays trace the fictional, picaresque accounts of violence done by characters such as Fagin and Bill Sykes in Charles Dickens' *Oliver Twist*, the thieves in Daniel Defoe's story *Moll Flanders*, and the highwaymen held in high regard by the populace in the famous play *The Beggars' Opera*.

Coming up to more recent times (late nineteenth and the earlier part of the twentieth centuries), Bronowski considers the gangster stories originating in the USA during the Prohibition era and the detective stories and crime fiction in English authors such as Dorothy Sayers and Sir Arthur Conan Doyle.
Dorothy Sayers created the character of the upper class Lord Peter Wimsey, and Conan Doyle the eccentric but educated Sherlock Holmes. Both Wimsey and Holmes are called upon, sometimes by the established police services, sometimes by outsiders, to solve crimes which the police investigate in a manner which depicts them as foolish and inept.

On occasions, the criminal is the hero in the story. With a touch of irony, Bronowski comments that these stories are read by educated men and women, even by those whom he describes as "mild mannered, bespectacled ladies."

Here in this account of the picaresque, and the Wimsey and Holmes crime fiction, is a clue to the more serious criminal acts of violence during the twentieth century.

I will now develop a framework to consider the content of essays 5 and 6, by setting out the epistemological facets of *The Face of Violence*.

Bronowski says "Men have a right to fear that society may unman them," because "The conditions of civilized living do much to sap our lives of adventure and risk." (Bronowski, 1954, pp 11-54). This, I believe is a profoundly important observation. Yet as Bronowski says (and has observed elsewhere in the thesis), "...no man has made the best of his gifts without the setting of a helpful society, such as the Greek or Italian city-states. This is the dilemma of man and state." (Bronowski, 1954, p11).

Bronowski puts the sensitivity of the word "dilemma" in a straightforward way when he says, "we are constantly called upon to solve the struggle between our need to be solitary ("free", as he said in lecture one of *The Identity of Man*), yet having to be social to survive, to be accepting of society to survive."

To survive, we need to obtain good food, water, shelter, which are the first of our "deficiency needs" according to Maslow. "Then as we develop, there are needs for the exchange of words, ideas, affection, esteem, which are the next set of deficiency needs we all have."

Pursuing the implications of the dilemma further, Bronowski says "The simple man's call for recognition in a society which too often treats him as another machine, is turned into a cry for revenge." (Bronowski, 1954, p55). He continues "Nothing he
does any longer seems a skill to be proud of in a world where someone else always hits the headlines. This is the plausible picture, in despair when men cheerfully join any private army, which will offer them the right to salute and be saluted." (Bronowski, 1954, p56). This is a foundation statement which Bronowski uses to create The Face of Violence. It can be understood why Bronowski says "This is a book about the motives which make men take pleasure in acts which deny and can destroy their own societies." (Bronowski, 1954, p12).

The reality of this statement is shown in essay 5, The Crime Story Come True, when Bronowski moves from past societies, from crime fiction into his observation that the first World War spun the world around, and showed almost by the way how easily our societies may fly apart. (Bronowski, 1954, pp40-41). On one level, he has shown this in earlier essays, but on the level of modern times, in for example, essay 5 he says "My subject is the growth within an orderly state of a conspiracy without cohesion whose only force is that it is anti-social. I am concerned with the centrifugal force of destruction." (Bronowski, 1954, p41). This is an interesting use of the word "centrifugal", normally associated with natural science, to describe human events.

In essay 5, Bronowski is referring to the event that "In Europe the story is more tragic. Here Mussolini founded the Blackshirts and Hitler the Storm Troops." (Bronowski, 1954, p41).

Fig 5.2 Mussolini and Hitler drive through Florence. (R Bosworth, Uniview)
What is to come in essay 5 regarding Bronowski’s personal experiences in Germany and his perception of Germany is powerful by its very authenticity, and he writes (and these lines come from the play itself):

"Those / who say that the past is done / And should be left alone / But by their acquiescence make / the present mimic every past mistake." (Bronowski, 1954, p51).

Bronowski writes: "I did not know the young men in Italy, but I did know them in Germany. Nothing in my mind to this day marks them off from the young men with whom I was at school in the same years in England ..... I did not much care for my German school. I could not feel even then" (remember that the Bronowski family moved to England in 1920) "that the men who ran it were passionate to revenge the defeat of the Entente, and to destroy the Republic which was to them obscurely the symbol and its instrument. But even as a boy I did not deceive myself that the boys were born that way ..... They were boys like me and the school exploited them." (Bronowski, 1954, pp41-42).

The generosity of Bronowski’s perception of the boys themselves brings to my mind Maslow’s account of the old Jewish gentleman driven in the rubbish cart through the jeering crowds in the Berlin street looking with pity upon them, as though he could see them as the then unexploited boys of their earlier years. I recorded this event in chapter 3 in discussion of the phenomenon of Transcendence in relation to William Blake.

Now Bronowski himself says something quite important which will link the essays to the play, and links the atmosphere of the essays and the play in destructiveness to the event of the atomic bombs on Japan.

Bronowski says "There was no shortage of destructive impulses to exploit in me or in any other boy. The itch to defy authority, the ache to be noisily, cosily one of the gang, and the nice conjunction of the two, which is got by banding together against the dago or the swot - they are to be tapped in any playground in the world. If you want to recruit an army for destruction ..... all you need to do is to exploit them. You need only to exploit their dreams - the weeping dream to become a man by defying authority." (Bronowski, 1954, p42).
There is so much implicit in that last sentence - Freud's Oedipal complex of the boy's need to murder the father, the need to salute and be saluted, the uprising against the sin of authority, the need to find one's significance as an individual man in a world, but I will leave these issues alone and return to Bronowski. He said that Germany in the 1920's was a country in which men were ready to drag out those nursery bogies (a good phrase to describe the infantile nature of the "weeping dream") as they might cry for mother because they had lost hope. (Bronowski, 1954, p42).

Bronowski, in the essay 5, continues to elaborate these ideas going back in history to such events as the "Tyburn mob", but I feel he has already explained the background of what is to come as Germany evolves into Nazism.

Bronowski continues: "the young men who had been at school with me had hoped to become bank clerks and dentists and civil servants and schoolmasters. But the demands for these accomplishments and the real salaries which they carried shrank desperately in a defeated country ..." (the inflation rate in 1920 was 1 million marks to 1 US dollar) "Himmler was a schoolmaster out of work ......" (later when he was a power in Nazi Germany, Himmler decreed that the stars were made of ice, and scientists and others had to believe this). "Men like these were the first to be swept into the Nazi movement in a bottomless revulsion against their own painful education and class ..... Hitler had suffered the same defeat of his aspirations to be an intellectual ..... He had the conspiratorial symbols of hate ready like a pack of cards: democracy, the bankers, Einstein and the Jews, the cosmopolitan middle class, the socialists, Versailles ....." (Bronowski, 1954, p43).

In *The Ascent of Man* both in the television series and the book, Bronowski said "the great men went out into a threatened world; Max Born, Erwin Schroedinger, Albert Einstein, Sigmund Freud, Thomas Mann, Bertholt Brecht, Arturo Toscanini, Bruno Walter, Marc Chagal, Enrico Fermi. Leo Szillard arriving finally after many years at the Salk Institute in California." (Bronowski, 1974, p367). Sigmund Freud defied the Gestapo right up to 1939 when he and his daughter Anna left Vienna for London.
Of the outstanding physicists who left Germany was Max Born, who "had a remarkable Socratic gift" (Bronowski, 1974, p362) and who was Werner Heisenberg's tutor in the latter's early studies in quantum physics in Germany. The irony here is that while Born left Germany, Heisenberg stayed on as a scientist working in Nazi Germany.

In *The Ascent of Man* Bronowski described, in pre-Nazi times how prominent scientists on the train from Berlin to the ancient university town of Göttingen argued and discussed and exchanged ideas. The train was, in a way, a seminar room as the scientists travelled to the famous university.

![Fig 5.3 Max Born (Bronowski, “The Ascent of Man” p361)]
In the television version of *The Ascent of Man*, there is a powerful sensation of a train's movement sweeping these men, physicists, novelists, musicians, painters, away from Göttingen which had become repressive under Hitler's orders, back to Berlin. As Bronowski commented "Now the train to Berlin was a symbol of flight." (Bronowski, 1974, p367).

Incidentally, Bronowski described Göttingen, Cambridge in England, and Yale in USA, as "provincial towns." He meant each of these three places were away from everyday occurrence and general social activity; they are places where students come to argue and debate with their professors.

Before resuming Bronowski's own reports *The Crime Story Came True* in essay 5, I would like to comment on the effect of the disorders in Europe in the Depression years of the early 1930's and with the rise of Nazism, on Niels Bohr's Copenhagen Institute. In its most renowned period from its opening in 1921 to World War II, scientists came from all over the world to study and exchange ideas on the developing quantum mechanics. There was one man from Australia, Marcus, later Sir Mark Oliphant, whose death at the age of 98 years was reported in August 2000. Niels Bohr created such an atmosphere of freedom from status and generated a
sense of "play" with ideas, that it was unique for its time. Ultimately, Bohr had to leave the Institute and his family in Denmark, when the Nazis wanted possession of him.

Returning to Bronowski's own studies of Nazi Germany and further noting that this is the "second catastrophe" as he uses that term, of his time. The first catastrophe, the atomic bombing of Japan, was discussed in the first part of chapter 4, and I would point out again that the placing of the two catastrophes in chapters 4 and 5 is why I have described them as parallel chapters.

Bronowski says the "conspiratorial symbols of hate" which Hitler had "ready like a pack of cards ... and at the turn of the card, Kashan and his homosexuals" (Bronowski, 1954, p.43), are only the first level of Hitler being an upside-down version of Leonardo's universality, a term that Bronowski uses to describe Hitler's disordered outlook.

Hitler then used a second level "to exploit the wilful dreams of civilized men" (Bronowski, 1954, p.43) the "wilful dreams turned these everyday men into 'sadists and perverts'" and they became the second level of "a crime against mankind." (Bronowski, 1954, p.44).

Using this powerful language, which would have explained how distressed Bronowski was, he continued: "The flagellants were made Standartenfuhrer. Vicious" (a word to be considered later in the play) "men like Heydrich, erotomaniacs like Streicher, and compulsive lunatics like Hess became men of power. In the Sudetenland, a strangler of prostitutes was made a judge, and" (to go back to essay 1) "we are reminded that the name sphinx means a strangler." (Bronowski, 1954, p.44).

These men created "Dachau and Ravensbruech ... In the slang of prisoners, a concentration camp was grimly called a Konzert. In the end, the whole people was made prisoner to that blood-drenched Wagnerian tumult." (Bronowski, 1954, p.44).

Horrifying though his description of the plight of the German people is, Bronowski still has a hint of sympathy or generosity to the people. To show the quality of his sympathy for the people, when some of them behaved violently, and others such as
the sadists and perverts turned the violence to evil vice, I have gone to some lengths to reproduce Bronowski's account of acts of Nazism. What I have referred to here about the ordinary cowed people will be discussed again when the play is reviewed.

It is important to follow through Bronowski's observation that "A whole people was made prisoner" and obedient to the Hitler regime.

In effect German people, from the schoolboys to the schoolmaster who became the infamous Himmler, whom Bronowski knew in his own schooldays in Germany, through to Hitler himself, were without positive Growth values. They abandoned any effort to try and transform the degenerate Weimar Republic into a self respecting community without recourse to Nazism.

The exhibition "German Drawings, 1918-1933" of which one by George Grosz is reproduced below, showed how Germany became decadent with cabarets as places where the decline of values of civilized self respect was apparent.

Joseph Royce (1921-1989), Head of the Department of Psychology, University of Alberta, Canada, in his penetrating article *The Search for Meaning* explores this matter. He says in discussing *The Problem of Meaningless* as part of his article that in the modern world "The freedom to choose one's values is too big a choice for the average man." Royce's article originated in a lecture to a conference in the US in 1958, and he said that the average man tends to drift and oscillate in the face of a multi-valued universe. The writings of the existentialists and of social psychologists and psychoanalysts even go so far as to suggest that man does not want the freedom to choose his values! Reisman's (1950) other-directed man would prefer to follow the herd rather than follow the dictates of his underlying individuality, not because he believes in the herd, but because there is a greater consequent feeling of security in following the herd. This idea of Reisman's relates to Bronowski's belief that rigidity in thinking is the avoidance of ambiguity in knowledge. Fromm (1941) a psychoanalyst takes the argument many stages further and points out that modern man prefers to be told what to do by strong authoritarian leaders, that he wants his values in absolute form handed down to him. Fromm says that a Hitler is a very understandable and perhaps an unconsciously desired product of our times, and that
we literally want to escape from our freedom. Fromm like Reisman is aligned with Bronowski.

Fig 5.5 Poster for an Exhibition at the Art Gallery of Western Australia.

There are other authors whom Royce uses to illustrate a basic concept in his paper, about the "encapsulated" man, who "is one who projects a knowledge of ultimate reality, or a world view from the perceptual framework in the personality with a limited reality image." (Royce, 1958, p517). "Ultimate reality" is an expression of Royce himself.

Returning to the Bronowski discussion, I also recorded Bronowski's account of Hitler and his followers, because it aroused in me as much bewilderment as Nicholas Humphrey did when he said "the atomic bombs dropped on Japan were the size of cricket balls!" Humphrey's paper urging public responsibility for human disasters, I referred to in chapter 4.

Bronowski continues to present his views and concludes essay 5 with the theme "I have steadfastly laid greater stress on the impulse to defy authority than the impulse towards cruelty in itself" (Bronowski, 1954, p 45).
I have not followed essay 5 further because the theme to defy authority and social uprising against those who commit the "sin of authority", has been discussed variously in the preceding essays.

Essay 6, The Cry to be Recognized, is a summary essay: all that has gone before is really a cry by men, women, and children too, to be acknowledged by recognition.

Rather than work through the material of the whole of essay 6, I will give an indication of its contents by listing the headings of the sections, and then present the essential themes, to link them with what has gone before.

The headings of the sections are The Machine World, What dictates Men?, Stand and be Recognized and Utopia at the Races.

Bronowski begins: "In all societies the individual suffers something of a split personality. The society nurses and sustains and yet he finds its pressure irksome and makes gestures to break out of it." (Bronowski, 1954, p52).

Primitive societies revolt against society by committing the scapegoat king to be mocked in one way or another; the destruction of the king being the ultimate. This is the early understanding in the series of the essays.

Then a literature develops around the "picaros, coney catchers, pirates and bohemians" such an example of the literature being The Beggar's Opera where the highwaymen were hailed as they went out to do their jobs, and

"The youth in his cart hath the air of a lord." (Bronowski, 1954, p53). Here the idea of the master criminal is developed as a power against authority.

Earlier in the thesis, in chapter 3, on William Blake and the Industrial Revolution, I gave many examples of Bronowski's understanding of the way Blake used obscure words to generate visual imagery, "Vala and the Four Zoas" being one example, so that Blake felt safer from the authority of government and Whig power as he perceived how The Machine World was destroying the earlier culture of people believing in God and Nature.
To continue, the gangster film and the detective story developed so "we canalize our secret dreams of revenge on the society that contains and thwarts us." (Bronowski, 1954, p53). Lord Peter Wimsey and Sherlock Holmes, both leave the "Flat footed law contemptuously behind us." (Bronowski, 1954, p53).

In *The Machine World*, Bronowski says "The violence of the lawbreaker becomes the symbol of manly action in the world of machines ..... one case at which I glance in my play is typical: Charley Jenkins who at 23 was hanged for leading the hold-up of a jeweller shop at which Antiquis was killed in 1947." (Jenkins himself did not fire the shot). "His gang of boys adored him ....." (Bronowski, 1954, p54). Shades of Fagin and his pickpocket boys are here.

Moving on, Bronowski states "Anti-social feelings in a hierarchic society like ours are first a power and then a commodity on which an unscrupulous leader can rise to fame, and become the spokesman for the dream of violence of all underdogs. Mussolini and Hitler recruited their followers with such slogans." (Bronowski, 1954, p54).

Although Bronowski wrote these words in 1950, unhappily the remainder of the twentieth century, and now into the new century continue to give examples of the dreams and practices of violence.

With respect to *What Divides Men*, Bronowski develops a theme in his work that has become apparent in later years. He wrote: "The lesson which history teaches us here is direct. It is that each man in society is driven two ways. He wants to be a member of society to belong and to conform. And at the same time, he wants to be a person, to act out his own will and to break the constraints of society" (Bronowski, 1954, p55).

This is Bronowski's solitary-social characterization of men, which can be enlarged to include the struggles of women in feminism, and further, to consider the rights of the child.

Bronowski alleges "All solutions to this dilemma are fakes ..... because they pretend to the rebellious man that he has broken out of the stranglehold of society and become a man for himself. And he never has" (Bronowski, 1954, p55). This is
the theme that Bronowski returns to in the section "Stand and Be Recognized." He asserts "This is why our world always seems to be on the edge of crisis" (Bronowski, 1954, p58), an observation I myself made earlier in this discussion.

Dealing with a way out, Bronowski says "The heart of social reform today is to make the world acknowledge the central place in it of every man's work" (Bronowski, 1954, p60). I don't think Bronowski simply means work as an economic livelihood, rather work as an activity that enhances a person's self respect and contributes to society's recognition of him, but never exploits him. This is a topic to be discussed at length in lecture 6 Law and Individual Responsibility in the series of lectures to come The Origins of Knowledge and Imagination.

Bronowski concludes essay 6 when he leads the way to the play, by saying "Is there a moral to this? That vice is a personal disfigurement, but violence is an impulse which we all share ...... Vicious men can exploit the impulse, ......" (Bronowski, 1954, p61).

What is so important in Bronowski's consideration is that violence is as natural as dissent. Society needs dissenters to progress. Bronowski concludes "Violence is the sphinx by the fireside, and she has a human face." (Bronowski, 1954, p62). In everyday words, Bronowski is saying that violence is a protesting man with the animal force in us all.

This statement opens up many facets of human behaviour about the dissenter, on to increasing verbal and physical violence. It seems possible to say that Socrates, Newton, Einstein, Freud, Darwin, and Gauss, to select some examples, and indeed Bronowski himself, can be regarded as men of dissent, and so were men of violence! And to include women, so were Lise Meitner, and Marie Curie.
5.2 **The Face of Violence**

Bronowski describes the play *The Face of Violence* as:

"A Portrait of the Motives and Manifestations of Violence in Modern Society" (Bronowski, 1954, p63)

There is a gallery of twenty-seven characters. The play has the central focus in an incident which took place amongst a variety of people, civilians and military guards, at a fictional place called Bosscamp.

Of the twenty-seven characters, there are first of all the heavenly twins one who is male whom he calls Pollux, and Castara who is female. They reside in the clouds of Olympus looking down on the earth and commenting on events.

Of the humans, the principal character is an emotionally tormented man called Mark. His wife is Lily, who plays a slight role. There are two other people, Crump and his wife Clarissa. The play revolves around Mark, Crump and Clarissa.

There is a miscellany of characters of the kind Bronowski wrote about in the essays - picaresque types; a foolish rather dull witted policeman; unscrupulous business men who run boxing rings, dubious night clubs and who are involved in financial matters. Their employees are variously named: Tiny, Creepy, Black Boy; and Carolus, another dubious character of some standing who appears later in the play.
Then Bronowski gathers some characters in a circus: the Circus Barker, Midget, and Sampson; and the clowns Snotty, Eggy, and Beaky. In another area there is a Hyde Park orator, an unemployed Scotsman, and a Cockney.

The variety of everyday names in the play indicates that Bronowski has written in the vernacular. The play, while it reaches a powerful conclusion, has an atmosphere of everyday life, and confirms Bronowski's own stated enjoyment in reading and writing in the "boney" English language.

The play is set in the here and now, with references to the past. For the sake of ease of following the written pattern of the play, I have divided it into five sections, although the radio version is given without a break. I would speculate that it would occupy an hour, more or less.

At the start of section 1, the setting is by the shore of a quiet summer sea in a small town. Mark, a carpenter builds small boats, and is well known in the village. Talking to the local postman, Mark learns that the people in the village know that he is going away. They sense that Mark is troubled by some problem, unknown to them.

Bronowski gives some clues to Mark's distress: "Twelve years ago, when they took him away ....... he stares and thinks ...... something is driving me ...... I have to look for someone ........" (pp69, 70, 72).

Twelve years ago, Mark was "Very respectable, fought on the right side, three years in enemy hands, I'm looking for a man and I can't remember his name" (pp70 - 72).

Despite Mark's wife Lily's puzzlement and distress, Mark sails away from the village to arrive at Saint Argent.

Section 2 now begins. Saint Argent is a grubby seaport town, known for collaborators from the past and various grubby characters in the present (pp 75 ff).

Mark's experiences in Saint Argent centre around a collection of dubious characters - Tiny, who runs a boxing ring, and what seems like a night club; and his henchman, are Creepy, Black Boy, Wall Eye. Mark finds himself in scuffles with Tiny and his men, and he is thrown out by the bully, Black Boy. Tiny describes Mark to his men as "A comic, boys, a real comic. We have been privileged with a visit from a real
comic …... on a busy night we have to spend our time talking to a comic." (p 80). So Mark, trying to find Crump in Saint Argent, only earns denigration of himself.

Leaving Saint Argent, Mark travels inland, and in section 3 he is a cleaner in a circus. Mark seems to have declined in self regard, although Bronowski still presents him as a person of some value to himself, and to some others, especially two of the circus performers, the Midget, and Sampson the Strong Man. Midget is given to drink, while the Strong Man has his own concerns, "Bring up a big weight with your ears fit to burst wondering how many more lifts you have got in you." (p89 ff).

While the Midget and the Strong Man tease each other, Mark is rather kind and respectful to them. Despite his pursuit of revenge, Bronowski portrays Mark as still capable of sensitivity to those with their own personal concerns like the Midget and the Strong Man.

And now the play begins to move towards its purpose of explaining Mark as one of the characters with Crump, yet to come, as having The Face of Violence.

The move forward begins when the Midget calls to Mark ".....The ringmaster says you're to go in with the clowns and help clean up the ring when the lion act is over." (p96).

So in front of the audience Mark takes his broom to clean up the ring, and the three clowns Snotty, Eggy, and Beaky appear. They tease Mark about his alleged girlfriends, and Eggy says "They say he's ever such a nice man. Ever so clever, really wizard". Beaky asks "Wizard, Can you ride on a broomstick, Mr Mark?", and Beaky "thrusts the broom between Mark's legs and he falls heavily" (p97).

Now the clowns together begin to denigrate Mark. With the circus audience looking on they strip off his shirt and trousers, which causes Mark to experience a "nightmare …... Snotty says "And how can he go looking in his underwear for a man called Crump. Mark calls 'Stop! Stop! Stop!'" He says "I was back in the guardroom the day they took me away, with our guards clowning and the enemy standing by bursting their flies with the joke. I was back in the dream I used to have
before I came back. I've made a beginning, Lily! I'll find Crump yet! I will! ......" (p98).

The vulgarities of the three clowns in the circus is reminiscent of the poet William Wordsworth's distain for the showground antics in the city, which he describes as: "what a shock/ For eyes and ears!" Wordsworth's description of the fair is in his poem *Residence in London* discussed in chapter 2.

Bronowski changes the scene again and section 4 begins. After the fracas Mark "was arrested after the fight in the circus last week" and "He came out on bail this morning." Now a new crook Carolus, apparently a shady financier comes into the action, and it is he who put up the bail for Mark to be released. The immediate conversation in this new section was with Juno, his secretary. (p101).

Mark is shown into Carolus' office, Tiny and Black Boy arrive from Saint Argent, and Mr Carolus tells Mark that he wants to employ him, not to start fights, but because Mark now has a reputation for being in the midst of fights and brawls. It is as though Mark, looking for Crump, acts out his search in disreputable places and circumstances.

Mark denies what Carolus attributed to him, and Black Boy, the small fry in the Tiny - Carolus set-up, says: "Don't he ever say nothing different?" (p105). Bronowski's flexibility with the English language is again shown.

Mark defends himself against Tiny and Carolus who try and make out that Mark is just mistaken in fixing on his search for Crump, "some little crook that's done him dirt once. Only it's been on his mind so long he hardly knows what it is." (p106).

Bronowski now gives Mark the opportunity to elaborate more of his experiences of Crump, as the play moves on to its climax. Mark replies: "Crump wasn't a crook ...... (remembering more of the past) he was a prison guard of some kind, or an executioner of some kind, with a sly, bad-tempered face like his name: Crump ...... I can't remember what he did except that it went with his face. He was vicious and he was evil." (p106).
Tiny comes in again saying "Everybody has a little appetite for a gamey kind of fun, with a spice of pain in it ...... (said with relish). Everybody's glands squirt when they'd like to break someone's nose and hear it go crunch. But they don't make a life work of it, see" (p106). "...... it's no use getting those people mixed up with vice and evil. Vice and evil are stuff for the strong - for company way above your head, Mark ......" (p106).

Tiny is trying to entice Mark into the lower levels of crooks, and what Tiny just said to Mark is reminiscent of Bronowski's belief expressed in The Identity of Man in the last chapter, that we all have a dark side to ourselves, but we don't necessarily act it out. As well, thinking of Mark's situation, and Bronowski's comment about the dark side to ourselves, brings to my mind Bronowski's description of how he saw Nagasaki when he first landed there as scientific deputy to the British Chiefs of Staff Mission. This is another reason why I say that chapter 5 parallels chapter 4. Chapter 4 opens with an account of Bronowski's description of his perceptions of the destruction of Nagasaki, and led him to write a book relating science and human values. Chapter 5 opens with The Face of Violence which seems to be related to the other catastrophe of his life, the destruction of knowledge and human beings during the rise of Nazism.

The heavenly twins debate between each other what they hear from Carolus, Tiny and Mark and Pollux says to Castara:

"Violence has a face which is most commonplace" (p109).

With this clue to the outcome of Bronowski's thesis about The Face of Violence, the last section, section 5 emerges: the scene is Hyde Park, with a crowd listening to an orator urging them to rebellion about social injustices. On a bench listening is Mark and beside him an unemployed Scotsman, himself a carpenter. Their conversation makes a passing reference to a picaresque character Charley Jenkins, a Fagin-like person with his gang of young boys who adore him.

The Scotsman says the young people seek people "Like a crooner; That's what you must do to make your way, a crooner. A crooner or a film star. That's all the young care for. It's the corrupt influence ......."
And then someone in the crowd "An insignificant little man standing near them: he speaks with an indeterminate foreign accent" and says "A beautiful speech, straight from the heart, beautiful. A wonderful man. He sounds like the leader himself." (p116).

The reference to the leader reminds me of Bronowski's discussion of Hitler, the Fuehrer.

Mark recognizes Crump and confronts him. He forces Crump to take him to his house, where the final scenes of the play are acted out.

Mark demands that Crump listens to him, despite Crump's feeble attempts to dismiss Mark's charges against him. Mark recalls a young boy at Bosscamp pushed down a chalk pit to his death, while Crump and the other prison guards were laughing at what was going on. The boy's mother Clarissa looks on.

Crump recalls the incident and says "I was ashamed and yet I felt released. I felt a flood of revenge." (p121). Crump goes on to explain to Mark, how he carried distressing memories of his own childhood, of his father violently throwing his mother out of their house! He further explains to Mark that as he grew up he regarded himself as a 'nobody' (p121) craving for a Leader to give him significance. This is Bronowski's principal theme in the essays, especially essay 5.

Crump makes a moving appeal to Mark to understand how he and many other boys of the time 'hunger for a mission' and despite his cravings for esteem, Crump can only become a prison guard!

Bronowski's generosity of spirit in understanding the enemy, expressed in Crump's appeals, heard on the radio broadcast, must have been a principal reason for the play being held in such high regard. To the listener - and to the reader too - Bronowski has adroitly put Crump in a position of sympathetic understanding; while Mark, although a prisoner at Bosscamp, was only an onlooker, is now regarded as a man unreasonably seeking revenge.

Now the play builds to its climax. Crump's wife Clarissa appears. To Mark's astonishment he recognizes Clarissa as the murdered boy's mother, and as she
explains herself Mark realizes that he has to acknowledge to himself that he is a misplaced revengeful man.

Clarissa explains to Mark, that she and Crump "are happy in our marriage." (p125). With eloquence and depth of feeling she goes on:

"Justice is not enough. The convictions of the mind are noble but they are not enough. Only loneliness is enough and misery; only pity and human warmth. Compassion is enough, but memory is not. You and your charged memory, you're so wrought up about these big, inhuman thoughts, they work in you like a drug." (p124).

Mark answers: "Nothing works in us but the past. What works in me is history." (p124) and Clarissa responds: "That's right you're oversize with history ..... you used to be a good man. Now you have the look of someone chosen to be the hand of God ....." (p124).

Clarissa concludes her expression of the depth of her feelings when she says (both to Mark and Crump): "..... There are times when I am lonely. We are ALL lonely. What have we learnt Crump, you and I, in these years when we've talked about everything except our thoughts? We've learnt to pity one another for being alone. and we've learnt that nothing remains to be discovered except compassion. (my emphasis) There is nothing else in yourself worth the finding. At the end of years of despair, there is nothing to grow in you as tall as a blade of grass except your own humanity. Everything else is a form of loneliness. We lonely people must give one another pity. Otherwise we are alone like animals." (pp124-125).

What a marvellous speech from the pen of Bronowski! Profoundly moving climax to the play. No wonder it shared the 1951 Italia Prize.

Clarissa's thoughts and expression of compassion summarize the ideas of Transcendence of Abraham Maslow, they express the quality of the old Jewish gentleman to have pity on the jeering Berlin crowds, and they are reminiscent of the writings of Viktor Frankl, when he described how as an adolescent boy he survived Auschwitz by finding meaning in helping other people.
Bronowski summarizes the six essays and the play with a conversation between the heavenly twins. I will not record all that they say, because much is straight from the essays, but I will present part of Castara's contribution:

... the dispossessed
The sad anonymous

And having long been denied
Any personal pride
One day they meet a leader
And explode in violence.

Life stares at the man
Out of the stoney eyes of his boyhood
And the man shivers to think
What he has become.
If the stoney face will not flinch
Under his pleading look,
Forgive the man his violence ...
For violence has a human face

(pp 127 - 8)

The play written in 1950, must have remained in Bronowski over the further years of his life to find expression again in *The Ascent of Man* in 1973. The link is made when Bronowski kneels in a pond of ashes from the crematoria of the victims of Auschwitz. Bronowski passes his hand over his forehead, seemingly a gesture of distress, as he speaks of the destructive outcome of those who seek "certain knowledge," and his desire that these persons give way on the "itch for certain knowledge." Here he is referring to how human violence evolves into evil behaviour when people hold on to their resentments and seek a leader to guide them. The pictures of Bronowski at Auschwitz are recorded in chapter 1.

I referred to Epistemology and social behaviour in the title of this chapter. In his discussion with George Derfer, and in the lectures *The Identity of Man* Bronowski made clear that poetry and drama as sources of knowledge about human affairs were characterized by ambiguity and a "no moralizing" attitude. *The Face of Violence*, especially in the dialogue between Clarissa and Mark and her husband Crump, very clearly shows these two qualities. Clarissa doesn't moralize about Mark's desire for revenge, or for Crump's seeking a Leader to build his self esteem which was never developed in childhood, or in his adult life; it is Clarissa who transcends violence.
Rather Clarissa shows how the two men come to be as they are. As Castara said: *Violence has a human face.*

As to the ambiguity aspect of the play's conclusions, one is left with questions - what will Mark do now when his revenge cause has been shown to be fruitless? Will Crump be able to grow up out of his memories of his own childhood and the pain he suffered when he saw his mother ill-treated? These are the dilemmas of human life, and they show how the drama enlarges the inner self of the listener or reader, and how the reader or listener looks anew at himself or herself and at other people.

Both Mark and Crump could move to the next phase of human personal development out of their deficiency motivations into self actualizing qualities. These are the ideas of Maslow whose humanitarian values bore a remarkable similarity to Bronowski's.

Even further back in time, I am reminded of the opening lines of Sir Philip Sidney's poem *My true love hath my hart.*

*My true love hath my hart, and I have his,*

*By just exchange one for the other giv'ne*

By just exchange could Mark and Crump and Clarissa eventually accept their humanity? Could all three experience compassion?

To round out Bronowski's perceptions of the self, I have heard it said that modern day women students don't take kindly to Bronowski's writings because he uses the gender term the word "man" or "mankind" to include humans of both genders. Such women students could well read Clarissa's expressions of compassion to realize that Bronowski must have held the feminine gender in high regard as persons of generosity of outlook, capable of warmth of forgiveness to enhance human wellbeing. The dedication to "Jacob Bronowski" which his daughter Lisa Jardine uses in her book *Ingenious Pursuits* (1999), referred to in chapter one, gives weight to this point of view.
5.3 The Origins of Knowledge and Imagination.

Human wellbeing continues to be the concern in the second phase of this chapter (in parallel with the phases of chapter four), with the study of "human specificity" expressed in The Origins of Knowledge and Imagination. From this seemingly straightforward title of six lectures delivered in 1967, later published in 1978, comes the reason for the words "develops and deepens his epistemology" which I have used in the title to this chapter.

It is reasonable to regard these lectures as showing the influence of Bronowski's presence at the Salk Institute. The lectures move widely and deeply into epistemology at a "didactic" level. Thus, I considered it appropriate to present a photograph of Bronowski surrounded by his colleagues at the Salk Institute in January 1974. The photograph was taken from "The Salk Institute Newsletter; a special edition, in memory of Bronowski, following his death in 1974".

The Origins of Knowledge and Imagination were delivered "On the foundation established in memory of Mrs Hepsa Elly Silliman, the President and Fellows of Yale University present an annual course of lectures designed to illustrate the presence and providence of God and manifested in the natural and moral world. It was the belief of the testator that any orderly presentation of the facts of nature or history contributed to this end more effectively than dogmatic and polemical theology, which should therefore be excluded from the scope of the lectures. The subjects are selected rather from the domains of natural science and history, giving special prominence to astronomy, chemistry, geology, and anatomy. The present work constitutes the forty-fourth volume published on this foundation".
Bronowski would not have found the word "God" out of place for two reasons. Firstly, as I referred to in chapter one, Bronowski accepted his responsibility as a Jew to express himself in the most effective way he could, and he took it as his responsibility to present knowledge to his fellow beings. He certainly would have been pleased to know that the testator, Mrs Hepsa Elly Silliman believed that the "presentation of the facts of nature" should be valued over dogmatism, which would be associated with "the itch for certain knowledge", as Bronowski used the phrase.

Before embarking on an account of the six lectures, I would like to record some aspects of the Foreword as given by S E Luria (p ix-xiii).

Fig 5.7 The Resident and Non-Resident Fellows with President Frederic de Hoffmann at the Annual Meetings January 1974. Salk Newsletter following Bronowski's death

Fig 5.8 Salvador E Luria
Salvador Luria (Turin, Italy, 1912-Mass. USA 1991) shared Nobel Prize for medicine with Max Delbruck for viral research studies.

Luria begins his Foreword by recounting an anecdote: "A physiologist friend of mine ..... as a refugee from Germany studying in a British country school during World War II, he was cruelly treated for his bookishness and Jewishness by the schoolmates until a sudden change took place. One evening the students were taken to a neighbouring town for a public lecture on science in the modern world, and from then on the students treated their refugee colleague with a new respect. The lecturer who in one hour had made both culture and Jewishness respectable and even glamorous to his youthful audience was Jacob Bronowski." (Luria, 1977, pix).

Luria's anecdote confirms the account of Bronowski's enthusiasm as a public educator, given by his wife Rita early in their marriage. This I mentioned in chapter one.

Luria continues his survey of Bronowski's public activities right up to "his (Bronowski's) approach to the mass audience in the monumental achievement of The Ascent of Man." (Luria, 1977, pix).

Luria regards the Silliman Lectures as developing in more detail the issues which Bronowski recorded in Science and Human Values and The Identity of Man. Both these works, says Luria "represented audacious leaps from the domain of science into explorations of central aspects of the human condition" (Luria, 1977, px). I agree with Luria's perceptions which is the reason I have paralleled chapters four and five.

As to the Silliman Lectures, Luria comments further that Knowledge and Imagination according to the author (Bronowski) are two inseparable aspects of the intellectual experience. The imaginative moment is as creatively central to science as to poetry or to figurative art. (Luria, 1977, px).

Now I have presented Bronowski's beliefs about the "imaginative moment" in every chapter of the thesis. So what does Luria regard as especially distinctive in "The Origins of Knowledge and Imagination"? He says "The lectures are both more technical and more openly didactic" (my emphasis because in coping with The
Origins I was confronted with difficult ideas which demanded much thought, partly because some of the ideas, eg. the axiomatic knowledge seemed to contradict geometrical axioms which I with so many others were taught, almost as sacred, in our schooldays).

In The Origins Bronowski describes himself as a "natural philosopher" as he deals with the complexities of self referential limitations in generating knowledge, the "metaphysical" ideas from the Talmudic (Hebrew) assertions that everything in the universe is connected to everything else, and more. The "more" centres on the intellectual unity ...... of the two themes - the role of the conscious human activity in the creation of knowledge and the imaginative content of that knowledge. Here I have paraphrased Luria (pp xi-xii).

Luria concludes his Foreword by reminding his readers that Bronowski was a Blake scholar, and that William Blake, like his contemporary Goya "pictures human folly as the stuff of nightmares, to be dissipated by the light of reason. Bronowski has confidence in human reason. His lectures breathe optimism, an optimism not unlike that of the thinkers of the Enlightenment, but sobered and refined by the modern view of nature and of the place of the human mind within it. Whether or not one shares Bronowski's optimism, one must be grateful to him for proposing it. Once again, as in that provincial English town where he lectured, one evening thirty-five years ago, Bronowski brings to his audience a message of human harmony." (Luria, 1977, pxiii).

Again, I find myself in accord with Luria's observations about Bronowski's belief in reason, the integration of the creation and imagination that generates knowledge, and further what I have referred to in other parts of the thesis, Bronowski's generosity of spirit as he looks out at human affairs.

It is for all these reasons that I chose the three extracts from Blake, Maslow, and Bronowski himself to introduce this chapter. Blake, the visionary, looking ahead, expansive and gentle; Maslow bringing Blake's visions to practical realities in daily life; and Bronowski's distaste for such as Hegel who callously disregard the world around and propose ideas that are irrelevant and misleading. Bronowski's plea from Oliver Cromwell: "...... think it possible that you may be mistaken" (Bronowski,
1974, p374) connects with Hegel's dissertation that there could only be seven planets, at the time when a small eighth planet was discovered.

It is time to move from Luria's Foreword and my perceptions and reactions about The Origins of Knowledge and Imagination to the contents, the titles of the six lectures:

1. The Mind as an Instrument for Understanding
2. The Evolution and Power of Symbolic Language
3. Knowledge as Algorithm and Knowledge as Metaphor
4. The Laws of Nature and the Nature of Laws
5. Error, Progress, and the Concept of Time
6. Law and Individual Responsibility

5.3.1 Lecture 1

The Mind as an Instrument of Understanding

Lecture 1 is about the "Mind" as the ultimate instrument of understanding built up from the "eye" (my emphasis) as the device by which we know the world outside ourselves, and the ear, by which we know world inside ourselves and between one another. Both the eye and the ear are interrelated as conveyors of knowledge. and give significance to these two senses Bronowski begins the lecture with a poem by W B Yeats:

For Anne Gregory

Never shall a young man,
Thrown into despair
By those great honey-coloured
Ramparts at your ear,
Love you for yourself alone
And not your yellow hair
Anne Gregory replies to the man
But I can get a hair-dye
And set such colour there,
Brown, or black, or carrot,
That young men in despair
May love me for myself alone
And not my yellow hair
and the young man responds
But I heard an old religious man
But yesternight declare
That he had found a text to prove
That only God, my dear,
Could love you for yourself alone
And not your yellow hair

(W B Yeats in Bronowski, 1978).

Bronowski shows "how we get experience which is not directly physical through physical means" (Bronowski, 1978, pp 3-4). Generalizing, Bronowski asserts we get "fundamental human abilities" (Bronowski, 1978, p4), from the physical senses, and other physical capabilities in ourselves – smell and kinesthesia for example.

As he did in The Identity of Man Bronowski links his interest in knowledge from the senses back to the early studies of Immanuel Kant, the eighteenth century scientist when Kant was still a scientist pointing out that our knowledge of the outside world depends upon our physical, biological being. Bronowski describes Kant as a scientist because his early interests were looking out on the physical world.

Bronowski says since the word "knowledge" is in the title of the six lectures, he is going to talk about epistemology. He refines what he personally means by epistemology. He means "natural philosophy" because the six lectures overall will be concerned with "lawfulness rather than with laws, and with the general nature of laws rather than the specific structure of this or that law ...... " (Bronowski, 1978, p4). It is for this reason that I used the expression “develop and deepen" in the title of this chapter, and I agree with Luria that Bronowski becomes "technical and didactic." (Luria, 1977, pxi).

Bronowski makes a basic comment illustrating his belief about knowledge when he says " ...... we become more and more aware that what we think about the world is not what the world is but what the human animal sees of the world." (Bronowski, 1978, pp 4-5). The young man loves Anne Gregory for the colour of
her hair, her yellow hair; only God loves her essence. Sir James Jeans, scientist whom I quoted earlier in the thesis, is at one with the spirituality of Yeats, the poet, when he observed "the universe begins to look more like a great thought than a machine." (Wolf, 1981, p226).

I think Bronowski's explanation of his epistemology as natural philosophy accords with what I imagine Mrs Silliman had in mind in sponsoring the lectures.

Remembering that Bronowski is at the Salk Institute, immersed in biology, it is appropriate for him to progress to the assertion "I want in particular to take us through the biology of the modes of perception, of speech, and of symbolization, and therefore, of the evolutionary" (my emphasis) "steps by which man has reached his biological situation." (Bronowski, 1978, p6).

Bronowski continues: "Running through all these lectures and underlying my interest in this problem is a quite simple question: what kind of animal is man? ..... I want to introduce it by saying something about the relation of the view of man as an animal and a view of man as a spirit. All animals are very special. They are certainly not simple engines. And man is a very special kind of animal."

Bronowski says: "While we shall be talking in these lectures about human beings as a special kind of animal what we are interested in is the word 'special' ..... it is of special importance to ask ourselves what features, which other features, which other animals do not possess, have given human beings the very capabilities with which we are concerned in this lecture; the ability to utter cognitive sentences, (which no other animals can do) and the ability therefore to exercise knowledge and imagination ... the most interesting thing about man is that he is an animal who practises art and science and in every human society practises both together"

Bronowski lists a variety of features specific to man: "Man alone adopts the frontal attitude in sexual intercourse, only women in any of the primates have breasts permanently, we are almost the only primates that do not have a bone in
the penis. We could go on in the hundred and one details ….." (Bronowski, 1978, pp 9-10).

During my study of The Origins of Knowledge and Imagination, I included a reading of Vital Dust, the Origin and Evolution of Life on Earth, pt VI, by Christian de Duve.


Professor Emeritus de Duve's writing style is vibrant, bringing to life the evolutionary progress of the mind. If the ambience of the Salk Institute biologists were as vibrant as de Duve's writing, then the physicists like Bronowski and Szilard absorbing the atmosphere of the Salk would have been deeply stimulated. For Bronowski at least, his writings in The Origins do convey the sense of importance and vibrancy, as well as being technical and didactic. de Duve makes the general comment that human culture is a product collectively and cooperatively of the human mind. (de Duve, 1995, p257).

de Duve also deals with a characteristic of humans which relates to Bronowski's list of unique human qualities. Under the heading "Adam's Apple", de Duve observes: "one of our distant forebears must have acquired a trait that gave its progeny a decisive evolutionary advantage. What was this trait? The answer to this tantalizing question could come from those linguists who have studied the origin and evolution of language. It is possible that this ancestor was born with a genetic 'defect' that moved the larynx deeper down the neck. As pointed out by
the American linguist Philip Lieberman, from Brown University, this anatomical feature is unique to modern humans and appears late in development. In newborn babies, as well as chimpanzees and all other animals, the larynx is much closer to the mouth. Even the Neanderthal man who became extinct about thirty five thousand years ago, showed this disposition, according to Lieberman, although there is some disagreement on this point. It is our lower larynx that gives us the ability to emit a much richer variety of sounds than any other animal. What started the modern human line may have been the ability to speak, and with it, the power to communicate in an increasingly refined way and thus to conquer the world." (de Duve, 1995, p234).

These comments by de Duve, I believe support Bronowski's beliefs about human achievements in arts and sciences, and find their most developed expression in *The Ascent of Man*.

Now, to return to the consideration of lecture 1: having spoken about knowledge, Bronowski goes on to consider the word "imagination", in the title. He asks his audience, and his readers "to think of the following words: visual, vision, and visionary; and image, imagery, and imagination". (Bronowski, 1978, p10).

What is important here is to realize that these are all "words that we use about experiences of the kind that go into visions or images ...... connected with the eye and the sense of sight. "Imagination" is a word which derives from the making of images in the mind, from what Wordsworth, the poet, called "the inward eye"" (Bronowski, 1978, p10). For Bronowski, it is clear that very much of the intellectual activities of man are eye - conditioned. When you consider this observation and that of de Duve about speech, it can be realized how richly endowed we humans are.

Bronowski is aware of such richness when he says: "The sense of sight dominates our outlook on the outside world, whereas the sense of hearing is used largely in order to make contact with other people or other living things" (Bronowski, 1978, p 10). This awareness has been given attention in *The Identity of Man*. 
Science and art as integrated bodies of knowledge, are unique to Bronowski, as George Derfer observed in his interview with him, discussed in the last chapter. This distinctive quality of Bronowski goes back to his early years as a scholar at Cambridge University. The combination is not commonly found in scientists and the literary community.

Having asserted that the sense of sight dominates our outlook on the outside world, and "the place of the sense of sight in human evolution is cardinal" (Bronowski, 1978, p11), he proceeds to an extended account of how the sense of vision works. His account is somewhat more detailed and deeper than in previous studies. He is most concerned to remove any expectation or belief that the eye is like a camera, and that the brain is sensitive and finely tuned to the picture sent to it by the eye. As he says: "The most interesting thing about the whole physiological development of the human eye and brain is that fine discrimination is not achieved in that way" (Bronowski, 1978, p13), that way meaning a well adjusted camera, and a finely tuned receptive brain.

Bronowski says: "I shall come to this point of view again and again, particularly when I talk about brains, and machines in the fourth lecture. The brain does NOT achieve fine discrimination by pushing fine discrimination forward in the senses and by producing a more sensitive physical apparatus ...... the brain has had to solve the problem of achieving fine discrimination with a coarse apparatus. And in many ways you can say that about all human problems, whether in science or in literature, whether physical or psychological, that they always centre around the same problem: How do you refine the detail with an apparatus which remains at bottom grainy and coarse?" (Bronowski, 1978, p14).

Had Bronowski been alive in November 2000 to witness the confusion and disorder in ballot papers, in marking, in counting, and in the legal struggles in the U S Presidential election, would he have shaken his head sagely and said: "Of course the process is grainy and coarse" I think that he may well have reacted like that.

To put the question again, "How do you refine the detail with an apparatus which remains at bottom grainy and coarse?" (Bronowski, 1978, p14). Although his
response is more refined in *The Origins* than in the account of the eye given in *The Identity of Man*, he relies on familiar names, viz, George Wald, Ragnar Granit, and H K Hartline, all three physiologists of eye behaviour who shared the Nobel Prize in 1967, the year of Bronowski's lectures.

Bronowski gives a short, rather technical account of the work of George Wald in particular, because he wants to "make it clear that the eye does not form a continuous picture." (Bronowski, 1978, p13), but gives the grainy pattern back to the brain. I should say that in case it seems that Bronowski is labouring physiology, it will be seen, to use a visual term, that it all suggests Bronowski's belief that no knowledge is single-mindedly accurate. I will elaborate this point, as Bronowski himself does, as the lectures proceed, because single-minded accuracy is simply alien to human life.

Now to go back to George Wald. "He showed that when a single quantum of light strikes a rod or cone in the eye it activates the visual purple" (defined in the dictionary of Uvarov, Chapman and Issacs as rhodopsin) "back to a lower energy state of vitamin A ...... this short description tells you enough to make it clear that the **eye does not form a continuous picture**" (my emphasis) "..... we have a very coarse, grainy surface (because the rods and cones are being activated and reduced all the time)." (Bronowski, 1978, pp15-16).

Bronowski goes on to discuss how frogs, cats, rabbits see boundaries of curved and straight edges by the continual activity of the rods and cones, but since this was mentioned in *The Identity of Man*, I will not repeat it further here.

So Bronowski says, "The eye does not send back simple signals; the back of the retina has an elaborate wiring circuit which picks out (of the continual movement from visual purple to vitamin A) conjunctions which are meaningful to the outside world." (Bronowski, 1978, p16).

Further Bronowski explains the eye is made to see boundaries and curves and "exactly because such mechanisms for these things are built into the eye, we are constantly deceived about the nature of the outside world because we interpret it in terms of the built-in search mechanism." (Bronowski, 1978, p18).
Bronowski justifies "... this excursion into the mechanism of the eye in order to
say how central it has been to the evolution of human beings. We stand at a peak
in visual discrimination; we are utterly dependent on it. We are dependent on it
not only in looking outside but in looking inward.

The abilities that we have in the way of memory of symbolism and emblem, are
all conditioned by the sense of sight ... we cannot separate the special
importance of the visual apparatus from his" (man's) "unique ability to imagine,
to make plans, and to do all the other things which are generally included in the
catch-all phrase 'free-will.'" Bronowski concludes: "What we really mean by free-
will of course, is the visualizing of alternatives and making a choice between
them. In my view which not everyone shares, the central problem of human
consciousness depends on this ability to imagine." (Bronowski, 1978, p18).

Bronowski as ever is fascinated by the intellectual quality of imagination,
knowledge, and ultimately foresight - hindsight, which is so dependent on
statistical events, the great statistical up and down from visual purple to vitamin
A and back again in the rods and cones of the eye. Hence, any pursuit of
knowledge as a certain outcome is a false goal. In lecture 1 of The Identity of
Man, Bronowski himself discusses free will at more length. This is discussed in
chapter 4.

5.3.2 Lecture 2

The Evolution and Power of Symbolic Language.

Bronowski firmly sets his purpose in lecture 2 when he says: "I want to talk as
the title says about the evolution and power of symbolic language" and he adds
"the word 'evolution' will occur again and again in what I have to say."
(Bronowski, 1978, p22). Bronowski is going to become 'technical and didactic' as
he develops this theme, and he says: "what I have to say about human evolution
really has only been known in the last twenty years." (Bronowski, 1978, p22).

While Philip Lieberman considers the emergence of human speech from the
lower position of the larynx in the throat, Bronowski is not at odds with
Lieberman when he says: "Roughly in the last half million years, beginning at
most about a million years ago ... the brain of human beings, and their immediate
ancestors enlarged at a prodigious rate." (Bronowski, 1978, p23). So Bronowski is going to focus on the brain, and as a background he tells that "the brain of the *australopithecus*, a human precursor who lived roughly a million years ago weighed about a pound to a pound and a half ... the average weight of brain in this audience is three pounds ..... However brain weight is really not the crucial issue." (Bronowski, 1978, p23).

Bronowski had already had some familiarity with the *australopithecus* when he did statistical studies of teeth size of this ancestor for Le Gros Clark.

What is crucial for Bronowski's purpose in considering symbolic language, remembering that the overall considerations are about epistemology, are four special areas in the brain development:

(i) visual area has increased considerably, the actual density of brain cells increased by at least 50%
(ii) an increase in the area of the manipulation of the hand
(iii) increase in temporal lobe in which visual memory, integration and speech all lie fairly close together
(iv) great increase in the frontal lobes, which at present day understanding are largely responsible for the ability to initiate a task, to be attentive while it is being done, and to persevere with it.

It may seem peculiar to include the manipulation of the hand with brain function, but the way the hand is used can influence how the brain function operates and is used to gather knowledge and develop images.

Since the lecture deals with language, Bronowski, quite reasonably, goes on to give consideration to human speech, and he says: "..... I think that human speech is indeed a continuation of animal communication, and the interesting thing is to see where it differs." (Bronowski, 1978, p26).

It is awesome to think back to how the brain and the hand were used at Los Alamos, and how Bronowski's sense of sight and brain responded to his perception at Nagasaki.

To resume the topic of human speech, Bronowski has already given some attention to this subject in the previous chapter, but knowing his fascination with
human languages, not just speech, it is to be expected that he will deal with the topic again in these Silliman Lectures.

As to animal communication, I have condensed Bronowski's discussion by reducing his accounts of studies done on animals by various researchers. As he says himself: "The central thing to keep in mind about animal communication is that it is communication: an animal makes a noise or emits some other signal which influences other animals, not itself." (Bronowski, 1978, p26). It is clear that Bronowski means that communication between animals is not used to elaborate, or develop, expand, or enhance the animal's experience of a situation.

To illustrate what the words develop, elaborate, and enhance in human experience mean I would like to relate that one morning in summer, with the soft easterly breeze blowing, my wife Elizabeth and I were sitting on the north-west terrace of our house at Gooseberry Hill, looking through the trees to the sunlit foothills and on to the city of Perth.

I read to my wife Sir Philip Sidney's generous, sensitive poem O Sweet Woods which I have recorded in earlier parts of the thesis. To quote just the first few lines: "O Sweet Woods, the delight of solitarines! \ How much I do like your solitarines! \ Where man's mind hath a freed consideration \ Of goodness to receive lovely direction." (Sidney, in Auden & Pearson, vol i p499).

The contrast between the poet's sensitivity and animal communication is apparent when Bronowski goes on: "It would be pointless to say the animal is trying to influence other animals. I do not even know what you are trying to do when you communicate, and I certainly do not know what animals are trying to do. But it is clear that, for instance, an animal utters a cry of alarm because natural selection has operated in favour of those animals who uttered a cry of alarm and in favour of those other members of that species which heeded the cry and took cover. It is an obviously well worked out self-correcting survival mechanism." (Bronowski, 1978, p26).

Bronowski quotes a number of researchers including W H Thorpe (1961) on bird alarm calls, and von Frisch (1950, 1965, 1967) on the complex pattern of signals
between honey-bees when they signal a rich source of nectar, and Bronowski concludes, despite the variety of signals different animals can emit: "... we are in the presence of a direct signal, and a direct, entirely mechanized response." (Bronowski, 1978, p27).

Even baboons and rhesus monkeys which have been the subject of extensive studies by such as Zhukin of Russia, who has reported "although baboons can say a great many things in a very small number of grunts and cries (a barking sound which says danger), they have only one way to say any one thing." (Bronowski, 1978, p29).

Bronowski comes to the central issue of this chapter when he says: "now human language differs from this in a number of ways." (Bronowski, 1978, p29).

"First of all, the human response," continues Bronowski, "is rather slow compared to most animal responses ..... we do not answer at once. ..... we have a rather long delay period. This is certainly something physiological that happens quite early in human evolution, this delay time in the circuit between input through the ear, and output through the mouth. It really is the first thing that makes human response possible." (Bronowski, 1978, p30).

So far as I understand, this delay time does not seem related to the position of the larynx, and because it is so significant to human behaviour, I repeat Bronowski's words: "It really is the first thing that makes human response possible." The delay time allows us as humans to cultivate rationality, foresight and develop an understanding of personal understanding. Bronowski explains these features at length later in the lecture.

He observes: "We sometimes teach ourselves how to make this kind of delay." (Bronowski, 1978, p30). He recalls how his father advised him to count up to twenty when he was really angry, and I dare say we have all been given this parental instruction at one time or another!

From these instructions, Bronowski concludes that what the delay has done to human speech in general is to skill us in being able to separate information from emotional content, when we interpret or frame messages.
This quality has a bearing on human epistemology and is a feature leading to rationality that is highly valued by Bronowski. He confirms the value of the delay time and its influence on human thought when he says: "..... that is an enormous human evolutionary step. We have no evidence of that in any other animal ..... We are able to get at what the message says and to separate it from the emotional charge which the message also carries. This is not true of animals." (Bronowski, 1978, p31).

Using studies referred to earlier with bees, Bronowski points out that bees: "do dance when they are excited, but they also dance when they are not excited ..... the speed of the dance which carries the message whether the source of the nectar they have discovered is rich or poor, whereas in a state of excitement we would go wrong, you and I, pointing the wrong way, going too fast, and so on, they do not." (Bronowski, 1978, pp31-32).

While this account of the bees' speed of dance would seem to elevate them in communication skills, Bronowski makes a very important point as he moves towards understanding human language. What the bees do is "convey instruction. They don't convey information. The bees say that the honey source is rich, let's go for it. They cannot analyse and discuss the nature of the source of the honey, its suitability and such like information. Animals convey instruction - 'honey, go', 'danger', 'food', and so on but they don't convey knowledge and so they are unimaginative. Knowledge and imagination are human qualities. To say this is not to allow us to swell with pride over the animals, even our closest friends the chimpanzees. It is simply the way it is. It leads Bronowski to assert that being able to separate emotion, or in the case of the bees excitement, from the communication, allows foresight in humans to emerge. This issue, Bronowski is at great pains to emphasize; and leads on to lectures three and four. (Bronowski, 1978, p 32-33).

I would like to delay Bronowski's next step in explaining human language, by relating some lines from de Duve which are relevant here. Writing about *A Meaningful Universe* towards the end of his study *Vital Dust*, he says: "Thought ........ is a faculty whereby the universe can reflect upon itself, discover its own
structure, and apprehend such immanent entities as truth, beauty, goodness, and love."

To keep in mind what has gone before in this chapter, and what is to come in Bronowski's study of language, there are more thoughts from de Duve which Bronowski will take up later in the Silliman Lectures.

To examine further what de Duve considers about meaning in the universe, he writes: "What is important is not absolute truth, but the search for truth. In the same way, there is no absolute beauty, but a shared yearning for beauty. No absolute good, but a shared striving after goodness. Just see what different peoples have held or hold for beautiful or for good in different parts of the world, and at different times. To me, the main message should be one of tolerance for others, and of humility for oneself." (de Duve, 1995, p301).

What comes to mind to connect with de Duve is Bronowski's compassion of Clarissa towards Mark and Crump, which is the essence in his play The Face of Violence, and the discussion in essays four and five of that work about the rigidity of opinion and repression of open enquiry in science and the arts as Germany declined in the late 1920's and Nazism rose.

To continue Bronowski's discussion of the importance of humans being able to separate emotional charge from information, he develops this issue further when he says: "The subject of my lectures The Origins of Knowledge and Imagination would be inconceivable in a world of animal or machine language, because you cannot convey knowledge in a language in which these two things (information and instruction) are always indissolubly linked in the message." (Bronowski, 1978, p32). By information and instruction Bronowski refers to information and emotional charge.

In the evolution of human languages, there was the "emergence of foresight." (Bronowski, 1978, p32). Bronowski applies foresight as it first emerged, perhaps as long ago as two million years, to early primitive man, foresight by first using tools such as stones or rocks as axelike devices, and today chimps can be seen breaking off branches to dig out termites from trees. Bronowski gives other
instances, in birds for example (p33), but it is elementary foresight. This might suggest a contradiction of terms between the immediate and the looking ahead because it is foresight for immediate use, but it is not a confusion of words, because foresight as it evolved later in humans did begin to show a 'thinking ahead' quality.

Bronowski, in dealing with this 'thinking ahead' quality, as I use the expression, says: "Foresight is tied to the later development of the brain in the second thing that is special to human speech. This is what I call the 'prolongation of reference', the ability to use language so that it applies not only to what is going on now, but what went on, or what will go on .... Prolongation of reference is a part of human speech which is connected with the high selective advantage that foresight conferred." (Bronowski, 1978, p34).

Bronowski continues to develop the particular qualities of human speech. He says: "The third feature that is unique to human speech is internalization". As he said earlier, "animals address their species at large, or possibly even members of another species, either to frighten them off or to communicate with them, but they do not, so far as we can tell, address themselves. The internalization of language is a human phenomenon of profound importance." (Bronowski, 1978, p35).

So far then, features of human speech and language are:

1 Foresight
2 Prolongation of reference
3 Internalization

"Human beings" says Bronowski, "have a wholly unique gift in the use of language, and that is that they talk to themselves. Everyone does it all the time." (Bronowski, 1978, p35). He relates the internalization of language, not only to interpersonal situations, but also back to the tool making with stones phase of human society. A person chipping away at a stone, examines and considers each stroke, throws away the poor work, and goes on internally assessing each stroke with a new stone. So internalisation of language goes back a long way in human
life. In our own times when we use the words 'I wonder ......' as we work at a situation, the pondering or thinking uses words.

Bronowski moves on to the fourth feature, which is that gift linguists usually call the productivity or generativity of language, said to be unique to human language.

"Because of this strange gift one can say 'John loves Lucy' and 'Lucy loves John' ...... the words are in a different order and the phrases mean different things." (Bronowski, 1978, p36). This is perhaps why Bronowski described the English language as 'boney', the words can be manipulated so well in structure. He says: "This grammatical structure is called stratification, making layers of language, and it depends essentially on the fact that this message can be broken down into three different concepts, a man called John, a girl called Lucy, and an action called love. ...... human beings analyze the world in a different way from animals. They analyze it into objects and actions." (Bronowski, 1978, pp36-37).

This discussion is Bronowski considering words and actions, not as he did in his works on poets and their poetry, as in The Poet's Defence, not as he wrote The Face of Violence, nor the power of his first impressions of Nagasaki, but it is Bronowski, not being a linguist so much as continuing his study of the character of human specificity expressed in language. This of course relates to his epistemology.

How did this happen in humans, asks Bronowski. He says that animals communicate in sentences - "look out, a snake", "we need food". An example closer to home is that of our cat whom we have had for eleven years. When she stands in front of a closed door, she sometimes utters a sound, which is surely an instruction to "open the door". She will circle the kitchen floor nudging our shoes and making meowing and purring noises which we interpret as "I am hungry", and we bring out her food and put it on her plate.

Bronowski has to acknowledge that in humans "...... we learn to take the sentence apart. Nobody knows how this happened, and it is really the great mystery about how human language came to be ......" (Bronowski, 1978, p37).
Bronowski's persistent concern with human language and its fluidity and mystery, is not just sterile linguistics. In the next lecture is can be seen how important it is in human life.

And now following through the property of stratification leads Bronowski to say that humans have learnt to generalize what animals particularize, 'food', 'danger', and such like. We do both, we generalize and particularize, what Bronowski calls "reconstitution." We have built a world of outside objects, a world which does not exist for animals." (Bronowski, 1978, p38).

Arranging words in different ways, reconstitution beside internalisation, makes for humans, problems of consciousness, ie, 'of' being able to see ourselves as if we were objects in the world' as well as being inside ourselves.

Bronowski has listed now

1. Foresight
2. Prolongation of reference
3. Internalization

and having added

4. Productivity or generativity
5. Stratification
6. Reconstitution

concludes the second lecture by speaking "in the third and particularly the fourth lectures of all the difficulties that arise from this remarkable and wholly human gift that allows us first of all to separate ourselves from the outside world. We see that there is a world of things; we recognise it as permanent; we move it about; we are able to re-arrange it in our heads from 'John loves Lucy' to 'Lucy loves John' which no one supposes to be the same statement. And with that goes inevitably a sense of ourselves, sometimes also as an outside person. The Cartesian dualism between mind and body arises directly from this, and so do all the famous paradoxes, both in mathematics and in linguistics, to which I shall return." (Bronowski, 1978, p39).
And when Bronowski says: "to which I shall return," he really means it, as the study of lectures three and four to come, illustrate! These two lectures rank amongst the most didactic of his works in the thesis.

As my reading of the Silliman Lectures progresses, it has become apparent that Bronowski is drawing on his education and experience at least from his studies in mathematics at Cambridge; and his concern for science to be regarded as a human activity, essentially no different from other human experiences. Also he shows his experiences of biological awareness of animals and humans gained from his presence at the Salk Institute. Relevant to the topic of epistemology is the basic belief of Bronowski that knowledge is self-referential, and this belief is related to his Judaic awareness of the significance of the Talmud.

5.3.3 Lecture 3

Knowledge as Algorithm and Knowledge as Metaphor

When Bronowski titled lecture 3 as "Knowledge as Algorithm and Knowledge as Metaphor" he offers the basic clue as to what is to come in this particular lecture. He is not asserting that knowledge is algorithm and is metaphor, but as, meaning knowledge is not direct and a straightforward response to Nature or to ourselves. It is a secondary process or a second best process, secondary process or second best being my words to characterize the acquisition of knowledge.

Since I have had the advantage of knowing the content of all six lectures, I can understand why Bronowski begins lecture three by telling his audience - whom he recognizes as not all professional scientists - that he has set himself as did Immanuel Kant "early in his life to construct a natural philosophy which was based on the physical ability of human beings to receive and translate their experience of the outside world." (Bronowski, 1978, p43).

"Consciousness," says Bronowski, "is our mode of analysis of the outside world into objects and actions. And I pointed out at the close of my second lecture that it at once posed a problem of namely, that we also think of ourselves as objects and we therefore also apply language to ourselves." (Bronowski, 1978, p 44).
And now to a statement by Bronowski which I regard as a fundamental belief around which all of his intellectual understanding of humans is constructed. He says: "We treat ourselves both as objects of language and as speakers of language, both as objects of the symbols and as symbols in it." (Bronowski, 1978, p44).

We look in and out; into ourselves, hence poetry; and out of ourselves to nature, hence science; using science in the broadest sense. Bronowski, who by this stage regards himself quite rightly, I believe, as a natural philosopher, says that because we treat ourselves as objects and speakers of language, we regard ourselves as comprehending the universe. We need to bear in mind de Duve's belief that in trying to find the meaning of the universe we need to show tolerance and humility.

de Duve emerges in another basic belief of Bronowski that we are self referential, and he Bronowski goes on " ...... all the difficult paradoxes which go right back to Greek times and reappear in modern mathematics depend essentially on this. I shall be concerned in my next lecture with the implications of these paradoxes for the use of symbolism, both in literature and in science." (Bronowski, 1978, p44).

I think what distressed me as I grappled with these paradoxes was the awareness, more so the realization of how my school education and even my education in Psychology III especially at Sydney University in 1949 completely ignored this basic implication.

Now Bronowski proceeds to say: "If any single utterance has reshaped history it is this - the law of inverse squares ...... G = k m m^1 / r^2. Now we all understand that as a symbolic expression which describes in some way the structure of our experience." (Bronowski, 1978, p45). He then goes on, "Let me now write for you another symbolic expression which I take from The Auguries of Innocence by William Blake:

\[
A \text{ } \text{Robin Redbreast in a Cage} \\
\text{Puts all Heaven in a Rage}
\]

Another couplet which I find equally powerful is:
A dog starved at his Master's Gate
Predicts the ruin of the state


To stay with Blake's couplet, Bronowski says: "Now the extraordinary thing about that verse is that it appears to have none of the formal structure of Newton's formula. Yet it is a highly general statement ....... in some way we all know with an immediacy which we derive from language and experience what

A Robin Redbreast in a Cage
Puts all Heaven in a Rage"


Returning to consider A Robin Redbreast Bronowski is very assertive when he says: "It derives its general appeal from its high specificity, and that is the miracle of this kind of remark ....... (it) says something about the human situation, and not just a robin in a cage." (Bronowski, 1978, p46).

Of course the miracle is Blake himself, a visionary, whose poetry is as relevant today as when he wrote it, as Bronowski said in his studies of Blake which I discussed in chapter 3. Blake as a poet also exemplifies the universal, direct, absolute reactions of the genuine poet, which so impressed Bronowski in his considerations of The Poet's Defence.

Returning to the work of Newton and Blake, Bronowski says: "Secondly, neither statement has the form of a syllogism ....... It is my view that that is very foreign to human language, that no scientific statement and no poetic statement is of the form, 'all A's are B's.'" (Bronowski, 1978, p46).

Personally I have long thought syllogisms are unnatural to human language, and it is a pleasure for me to read Bronowski's belief. Bronowski rounds off this part of his lecture by saying of the symbolism of Newton and Blake: "This is a highly active kind. Do not be deceived by the equal sign. It says something which describes what happens when you do something." (Bronowski, 1978, p46).
Bronowski now begins to focus more specifically on scientific statements, appropriate to the *Stillman Lectures*, and he sets out his plan: "I am going to treat science as a language. I am going to say that this formula is a sentence in a language, that all such statements are sentences in the language, and that the way we construct this language mirrors the way human language evolved." (Bronowski, 1978, p46). In this manner, lecture 3 connects to lecture 2 on human language evolution, those five characteristics being relevant:

1. Foresight
2. Prolongation of reference
3. Internalization
4. Generativity or productivity
5. Stratification.

Bronowski goes on to make the special point: "That science is a rather peculiar language because it only contains statements that are in the context of a particular theory, true." (Bronowski, 1978, p47). Thus \( G = k \ m^1 / r^2 \) is true while \( G = k \ m^1 / r^3 \) is incorrect. This quality of scientific language in the context of a particular theory is something that Bronowski is sensitive about, since any misunderstanding or misinterpretation in the context of a particular theory could lend itself to regarding science as a rigid dogmatic activity of little room for creative thought. This issue was discussed in the last chapter and forms much of the thought to come in this chapter. I am also reminded of the dogmatism of Nazi behaviour when in the later essays of *The Face of Violence*, Bronowski tells how Himmler insisted that the stars were made of ice, and scientists in Nazi Germany had to acknowledge Himmler's assertion.

Now to continue with lecture 3. Bronowski says: "We are always looking for a language in science which mirrors the structure of reality." (Bronowski, 1978, p47). Bronowski makes the claim that language in science mirrors the structure of reality because scientific language evolved "in exactly the same way in which human language evolved from animal language, by analysing the sentence into constituents which represent separable entities in the outside world - things or action. So science constantly seeks in the descriptive sentences for separable
entities which can be perceived in the outside world or, more often have to be inferred speculatively in the outside world." (Bronowski, 1978, p47).

What we have to do, says Bronowski is: "To tease out the structure (of Nature) from the observational sentences when we make them into abstract sentences ...... we do it essentially by treating nature as, in Leibniz's phrase" (Gottfried Leibnitz, 1646-1716, a contemporary of Newton), "a gigantic cryptogram, a gigantic series of coded messages. And we seek to decode it in such a way that entities emerge which are conserved under various changes and transformations." (Bronowski, 1978, p48).

This I regard as Bronowski expressing another of his fundamental beliefs. The word 'cryptogram' fits well with the paradoxes and self-referential limitations of humans in understanding Nature as well as ourselves, which will be the essence of lecture 4 to come. In passing I want to say that I believe that one of the lasting contributions of Sigmund Freud was his awareness of how we use defence mechanisms to protect or distance ourselves from ourselves or other people. Projection, displacement, repression, condensation, regression, and rigidity are all aspects of the cryptogram to be decoded in the psycho-analytic process. Poets too, such as William Blake were experts in creating the cryptograms of human affairs.

Bronowski's reference to Leibnitz's perception is such a splendid way of expressing our perceptions of the outside world, that I want to present it again: the decoding or deciphering of the cryptogram of Nature is what we call science. I suspect that if this conception of science were put to the public as a regular practice, scientists would be regarded as people solving cryptic crosswords. As Bronowski says in another context, mentioned elsewhere in the thesis, there would be less "loss of nerve" by the general public in the modern world.

Bronowski gives examples related to the notion of cryptograms, both from men such a Newton and Einstein, about the entity called mass; and he gives examples from young children. I will present an example from young children. Bronowski says that decoding an entity such as mass "comes late in the development of children. Remember that children before the age of four are always very puzzled
when you pour liquid out of a tall beaker into a broad beaker, and say to them: 'Is it the same amount of liquid? Which would you rather have?' Without exception, the children say they would rather have the orange juice in the tall narrow beaker. And if you say to them: 'Why?' they say: 'Well, there is more.' And then if you say: 'But there is not more; I can pour it into here and pour it back', they are not in the least persuaded. Why should they be? Why should they regard it as a law of nature that orange juice remains invariant in mass when you pour it from a narrow thin beaker into a small flat beaker? That is a real theorem." (Bronowski, 1978, p49).

Bronowski continues to develop this issue when he says: "...... I mention that theorem only to remind you that all our prejudices about the external world tend to be built into the language of science. Then, when somebody shows that the whole thing is nonsense, that we put our prejudices into it, we are always taken aback. I mean, in 1900, if you said to somebody: 'Could my watch run faster if I were standing at the equator than at the north pole?' everybody would have said: 'But that is rubbish! Only children think that kind of thing.' When in 1905 Einstein wrote a paper in which he said just that, everybody said: 'But that is marvellous (sic). What a child's vision he has.' Which is true." (Bronowski, 1978, p49).

I would like to make some observations from contemporary psychology about the capacity of a thinker such as Einstein. Such persons, be they scientists or poets, must be able to let go the here and now perception of daily reality and regress - using that word in the healthy sense, not the neurotic closed-in sense - so that the imagination of the inner self may emerge. All of us do this in our sleep-dreams. E Paul Torrance describes such behaviour in daily-life well, with his characterisation of a creative person, which I referred to earlier.

Bronowski continues in the same vein contrasting knowledge and imagination with resolving the cryptograms of nature - a way of describing his epistemology I think – in his discussion of the imagination of a man called Olbers (1826) with that of Sir Herman Bondi, born Vienna (1919) British mathematician and cosmologist about what happens to the energy emitted by the stars into the universe. I will not take up further space by giving a detailed idea of Olbers and
Bondi and their imaginative account of whether daylight should be brighter than nightlight, Olbers paradox, or the contrasting view of Bondi that nightlight is darker than daylight and how his view leads to the idea of the expanding universe, because there are so many more paradoxical issues to deal with in these lectures.

What is important to Bronowski, is that when you challenge nature, whether with the orange juice in the beakers, the watch at the equator or the energy from the stars, "you rely on the fact that she does not cheat, that she gives back consistent answers." (Bronowski, 1978, p52).

Bronowski then explains a language of science. He says: "If we treat our knowledge of the external world in this way then we are constructing a language of science which has three features" (Bronowski, 1978, p 52). Note his use of the word 'language' which implies words, words being another very fundamental characteristic of Bronowski's beliefs, as well as lifting science out of the mystique of algorithms like \( G = k \cdot m \cdot m^1 / r^2 \). With respect to the language, Bronowski characterizes scientific language with three features which I have paraphrased:

1. Symbols which stand for concepts or inferred entities which have the character of words in these algorithmic sentences
2. There is a grammar which tells us how these things are to be put together, so that for instance \( G = k \cdot m \cdot m^1 / r^2 \) is a grammatical sentence, \( r^3 \) would be ungrammatical, and the algorithm would not be allowed in the language
3. Finally there is a dictionary of translations which relates a sentence like this to specific problems like determining the period of the moon.

He continues explaining: "These are the three characters of the language of science. The grammar is essentially the rules of operation, specified by the axioms; the dictionary of translation is essentially the way we apply the sentences to our common experience; and the symbols or concepts are the solutions of the cryptograms." (Bronowski, 1978, p52).

Further, Bronowski says: "grammar has to do with explanation, the dictionary has to do with the description, and the symbols have to do with those concepts with which the whole of our consciousness is now full, but for which the only
evidence for most of us is that somebody told us in a lecture, or that it says so in the text book." (Bronowski, 1978, p54).

Only those rare personalities who fulfil the characteristic of E Paul Torrance's description of the creative thinker, move out of the lecture-theatre or the textbook, be it in science or the humanities. And of science in particular, only those who consider they are practising natural philosophy - people like Niels Bohr, Albert Einstein, and Jacob Bronowski himself, are such people.

Bronowski instances "Words like hydrogen and helium, nuclear processes, inhibition in biology, inhibition in psychology, have become new words in our vocabulary. But they owe that existence to be decoded out of statements of this kind." (Bronowski, 1978, p54).

Bronowski says "I have been giving you a highly personal account of how we practise science. And the obvious question is 'Are we inventing the whole thing? You may say to me 'Aren't you just a thorough-going idealist? Do you really think that there are not any atoms?' ....... when we do this decoding are we discovering something which is in nature, or are we not? Are we creating the concepts out of which we make science, or are they hidden all the time?'"

Bronowski responds to his question: " ...... the world is, ...... pretty well divided into people who would like to think our analysis of nature is a personal and highly imaginative creation and those who would like to think that we are simply discovering what is there." (Bronowski, 1978, p55).

But of course, the latter are wrong. Those who at the end of the nineteenth century thought that there was little left of real consequence to discover about nature - Newton's gravitational inverse square law was akin to Divine Providence, as the Whigs, through Richard Bentley the Divine, asserted, was such an instance. As I discussed in chapter 3, William Blake was not readily accepting of Isaac Newton, for this reason.

Bronowski puts it well, when he says "Since then, the world has fallen about our ears. There is almost no scientific theory which was held to be fundamental in 1867, which is thought to be true in that form today." (Bronowski, 1978, p56).
Bronowski instances Max Planck who in 1899 "..... finally made up his mind that radiation came in discontinuous lumps ..... when he took his little boy for their usual walk he said to him 'I have today made a discovery as profound as Newton's' ..... Those were very prophetic words." (Bronowski, 1978, p56).

Knowing Bronowski's characterization of the rise and presence of Nazism as a "catastrophe" in the twentieth century, and about which he wrote his essay to accompany The Face of Violence, it is understandable that he would have added "And the ..... sad thing about them is ...that the little boy whom he took for a walk was, in fact, murdered by the Nazis because he took part in the plot against Hitler's life in 1944." (Bronowski, 1978, p56).

"Then Einstein's 1905 and 1915 - 1916 papers on general relativity substituted an essentially geometrical view of space - time ..... this really said, roughly speaking, that these two masses attract one another because they form depressions in space - time, and those depressions tend to make them run together, just as if you put two lead balls into a bowl of jelly. ..... It is a fundamentally different decoding of the same sentences." (Bronowski, 1978, p57).

This is a good example of decoding the cryptogram of nature, two masses interacting with each other.

Bronowski asks his audience: "..... was the decoding all a fiction? Is gravitational force a complete fiction?" (Bronowski, 1978, p 57). His answer, he regards "as a particularly important question in an audience like this which is not wholly composed of professional scientists ..... I believe that any theory that we as human beings make at any point in time is full of provisional decodings which to some extent are as fictitious as the notion of force in Newton." (Bronowski, 1978, p58).

Bronowski's explanation is another very fundamental feature of his epistemology. As I come to appreciate Bronowski more and more, I cannot emphasize this too highly.
He says "I believe that the world is totally connected: that is to say that there are no events anywhere in the universe which are not tied to every other event in the universe. I regard this to some extent as a metaphysical statement, although you will see as I develop it in the next lecture, it has a much more down-to-earth content than that. But I will repeat it: I believe that every event in the universe is connected to every other event." (Bronowski, 1978, p58).

Bronowski qualifies this statement of epistemology by saying, "It is ...... an essential part of the methodology of science to divide the world for any experiment into what we regard as relevant and what we regard, for purposes of that experiment, as irrelevant. We make a cut. We put the experiment, if you like, into a box. The moment we do that, we do violence to the connections in the world ...... we have always, to use another Talmudic phrase, to put a fence around the law, to put around the law of nature that we are trying to tease out. And we have to say, 'For purposes of this experiment, everything outside here is regarded as irrelevant, and everything inside here is regarded as relevant.'" (Bronowski, 1978, pp58-59).

Despite being practical about the practice of science putting a fence around the particular work being done about some particular issue, Bronowski's metaphysical epistemology does basically express his belief and his values. As soon as you put a fence around the work you are stating a value, and this confirms his belief that there is no value-free knowledge. This is one of the courageous acts of Bronowski's characterization of knowledge of science that lifts it away from the inclination of the public to regard scientists as bespectacled white-coated men and women isolated in their laboratory. In the next chapter when considering Bronowski 'in retrospective' carried out in 1985 eleven years after his death, some scientists prominent amongst them being Gerald Holton give much consideration to the ethics of the technology that comes from value-free science.

To return to the issue of fenced-off knowledge, and Bronowski's reference to 'Talmudic' fencing, there is an extensive article by James Hastings in the *Encyclopaedia of Religion and Ethics*, explaining that the *Talmud* concerned itself with life. It therefore drew little or no distinction between the secular and
the religious. Hastings says "The Talmud, which goes back far into the life of the Jews, saved them from stagnation. For the Talmud is a work of most manifold interest. It concerned itself with every phase of human activity. To record it intelligently - and it was assuredly so read - was a liberal education in the arts and sciences and philosophies." (Hastings, 1971, pp86-87).

A. Cohen in *Everyman's Talmud* gives an Idea of the range of topics, when he lists in the table of contents: *The Doctrine of God, God and the Universe, The Doctrine of Man, Revelation*, and various chapters on domestic life, social life, moral life, and the like. Cohen says "The Talmud for the Jew, is not merely a great literary production, which it is. It is not merely a great repository of law and ritual, which it is. The Talmud is a great fund of Jewish religious experiences and wisdom accumulated throughout the course of the ages." (Cohen, 1971, ppv-vi).

It is a rare occasion in all his writings, for Bronowski to call upon the Judaic culture. He uses the *Talmud* in relation to its metaphysical aspects to deal with the significance of knowledge and imagination in his epistemology. The other occasion I referred to in chapter one, was when he talked about the sense of individual skills and social responsibility as part of Jewish culture.

To round out lecture three, I would like to set down Bronowski's view of the consequences of fenced-off or fenced-in knowledge, because it is implicit in lecture four.

Bronowski says when he decodes the cryptogram in the fenced-in matter "I am certainly not going to get the world right, because the basic assumption that I have made about dividing the world into the relevant and the irrelevant is in fact a lie. In the nature of things it is bound to give me only an approximation of what goes on inside the fence ....... when we practice science and this is true of all our experiences, we are always decoding a part of nature which is not complete. We simply cannot get out of our own finiteness." (Bronowski, 1978, p59).

In the one sentence 'we simply cannot get out of our own finiteness' Bronowski gives his epistemology another basic quality from which no human can escape. It reminds me of de Deuve's statement 'What is important in this view is not
absolute truth ...... To me, the main message should be one of tolerance for others and humility for oneself. This I quoted earlier in the chapter. Bronowski's own statement from *The Face of Violence*, 'Violence has a human face' is relevant too. The fact that this line came from William Blake is another instance of the breadth of Bronowski's own knowledge and perception. There is also Bronowski's recourse to Oliver Cromwell's impassioned plea, "I beseech you in the bowels of Christ, think it possible you may be mistaken" when Bronowski kneels in the ashes of the victims of Nazism at the Auschwitz crematoria. (Bronowski, 1974, p374).

To assert the finiteness of knowledge is an appealing approach as an overall integrative statement in epistemology, whether in the humanities (and poets are not excluded) and the sciences.

Being constrained by our finiteness does not mean we are limited. Bronowski says "...... the reason why we have made such enormous changes in our conceptual picture of the world in the last seventy years is because we have had to push out the boundaries of the relevant further and further. ...... we have to do it in the same way that we invent any word in the human language - by an act of pure imagination." (Bronowski, 1978, pp59-60).

Bronowski now concludes this lecture *Knowledge as Algorithm and Knowledge as Metaphor* by calling on Isaac Newton. "Newton's was a tremendous mind" says Bronowski, as he illustrated how Newton developed the inverse square law and calculated the period of the moon. (Bronowski, 1978, p61).

Newton began by saying "If I throw a ball, it will fall to the ground. If I throw it harder, it will fall a little further off. I must be able to throw it just so hard that it falls exactly as fast (sic) as the horizon, and then it will go all the way around the world." Bronowski says "Beautiful ...... a gorgeous, highly imaginative conception. He drew a lovely diagram. The ball will fall all the way around the world. How long will it take? It is easy to calculate, roughly ninety minutes." (Bronowski, 1978, p60).
Then Newton pictured the moon "as if it were a ball which had been flung around the world - two hundred and fifty thousand miles up, but still it is up there. How long will it take to go round the world? Let us suppose, says Newton, that the value of gravity is given by the inverse square law .... it comes out at twenty-eight days .... They agreed pretty nearly." (Bronowski, 1978, pp60-61).

Bronowski now uses Newton's work "to see where the path from metaphor to algorithm always goes." (Bronowski, 1978, p61). The ball is the metaphor, the calculation of the moon's period the algorithm. Bronowski puts it neatly when he characterizes it "from the Blake phase to the Newton formula - that every scientific theory has to follow because it is a human section of the totality of the experience which excludes some of the connections which are there" (Bronowski, 1978, p61), Bronowski referring to Newton excluding other planets when he conceptualised the ball - moon thinking.

Bronowski concludes with a reference to Kepler's metaphor about gravity, but as Bronowski points out, Kepler's metaphor of gravity was wrong being based on earlier ancient metaphors. Kepler "had a very mystical turn of mind" (Bronowski, 1978, p 63) and his thinking about gravity was influenced by earlier imaginative minds like Nicholas of Cusa, a significant cardinal/scholar (1401-1464, C.E.) and before him in the fifth century, a father of the Church who called himself Dionysius the Arcopagite who said "God's love is universal, and it therefore infuses every piece of matter. And, therefore not only does God's love draw every piece of matter to him, but every piece of matter must be drawn to every other piece." (Bronowski, 1978, p63).

With this ancient conception of all things interrelated, Bronowski's lecture on metaphor and algorithm stops!

I have made this chapter five an extensive study of Bronowski's epistemology from his remarkable poetry-drama skills, as in The Face of Violence, to his fundamental beliefs in self referential knowledge and imagination in science and the humanities. To do less would not respect Bronowski's unique qualities.
5.3.4 Lecture 4


I introduce Bronowski's lecture four with my own reaction to the lecture.

Lecture four is about the formalization and axiomatization of systems and mathematical structures, the purpose of such systems to fruitlessly try and "attain the great wisdom that we" (scientists) "have had ever since the days of Thomas Hobbes and Newton: we will never be able to exhibit the whole of physics one fine day as a gorgeous system, with about six axioms and a few operations, and from that moment everything would fall into place." (Bronowski, 1978, p80). Bronowski concludes that formal systems are just that - formal systems.

I would say formal systems of thought, are inhuman, or non-human; or as Bronowski would say, no formal system can embrace all the questions about nature that can be asked. "Nature is not a gigantic formalizable system." (Bronowski, 1978, p80).

In essence, lecture four is an elaborate way of Bronowski showing by referring to mathematicians and logicians from ancient times to the twentieth century, that we humans are always self referential; whether it is expressed in poetry, like Yeats about the young man referring to Anne Gregory, or the person outraged by the Robin Redbreast in a cage presented by William Blake, or the man called Isaac Newton, who imagined a metaphor of throwing a ball to the horizon and letting it circle the earth. George Derfer's interview with Bronowski, which I recorded in chapter four on science, poetry and human specificity, is also a self-referential example of Bronowski himself.

Lecture four reveals the depth of Bronowski's epistemology as knowledge, and he shows to me how self referential knowledge is linked with the qualities of honesty, integrity, and dignity of labour in understanding knowledge and human relationships. In this respect, it is further strength to my own belief that
Bronowski, whether mathematician, physicist, poet, poetry critic, natural philosopher or public educator, is linked to Abraham Maslow, the humanist psychologist and to Fritjof Capra, the physicist of Bronowski's own time. The trio share empathy with humane changes in science in the twentieth century from understanding the simple technology of early man in stone chipping to create axes, to the 'new physics' (Capra, 1963, p83), and the depth of appreciation of humanity presented by Maslow.

In lecture four Bronowski says "that in some sense there is no ultimate truth accessible to us for the simple reason we have to make a cut in the universe in order to do the experiment at all ...... it is in principle out of the question that we should ever have an ultimate explanation. That would involve setting up experiments in which the whole of the universe was perceived from a God's - eye view ...... I have said all that again because it is what I have been working up to for three weeks, and today I am going to look at it in a more rigorous context, the context of theorems in mathematics." (Bronowski, 1978, pp69-70).

Bronowski continues "I am going to be talking about mathematics not as an abstract system, but as a formal language for extracting something from the universe." (Bronowski, 1978, p70). So here is another aspect of his epistemology.

Bronowski spends much time on the work of Bertrand Russell (1872-1970) who from 1900 on, tried to invent logic to make mathematics exact, "but the Principia Mathematica with Alfred North Whitehead was not published until 1910, shows that the devices he invented, the theory of types did not even satisfy him." (Bronowski, 1978, p75).

Fig 5.10 Bertrand Russell Stanford Encyclopaedia of Philosophy
Bronowski then proceeds to consider "that David Hilbert put the thing quite squarely. He said 'We really have to answer the following question. Is it or is it not the case that any sensible mathematical proposition that I can write down can or cannot be true from mathematical axioms?'" (Bronowski, 1978, p75).

Bronowski himself responds, not forgetting that Bronowski was PhD (Cambridge) mathematics "Now the question that Hilbert raised, and which was answered in the negative in the 1930's is this. Are there general procedures for finding short cuts? ..... there is no such procedure. And we take as typical, for instance, the theorem proved by Turing in 1936 which simply says you cannot be sure when a proof will turn up." (Bronowski, 1978, p76).

Alan Turing (1912-1954), English mathematician and logician, motivated by Kurt Godel's work, was a pioneer in computer theory, contributing important logical analysis of computer processes.

![Fig 5.11 David Hilbert](image)

There were others as well as Turing who answered in that way. Bronowski says very firmly, "There is no way of making mathematical decisions; there are always theorems whose proofs may or may not turn up." (Bronowski, 1978, p77).

Bronowski goes on to say "But in 1931 a young Austrian called Kurt Godel proved something much stronger than Hilbert, and which took Hilbert's problems in its stride." (Bronowski, 1978, p77). Hilbert's problem is described as an entscheidung problem meaning decision problem.
Kurt Godel (1906-1978) began life in Austria - Hungary and emigrated to the US in 1940. From 1953 he served as a professor at the Institute for Advanced Studies, Princeton. I have provided that brief biographical record because Godel was such a significant person, as Bronowski proceeds to show: "Godel proved that if you have an axiomatic system of this sort (a formal system, with formal symbols and formal rules of manipulation) there are two things wrong with it ...... if it is consistent then there are statements it cannot prove ...... there are also true statements it cannot prove." (Bronowski, 1978, p77).

![Fig 5.12 Kurt Godel](image)

Bronowski summarizes argument on this issue by his statement " ......if an axiomatic system is consistent, then there are perfectly intelligible statements which it cannot prove" (Bronowski, 1978, p 78). What a startling statement for a man such as myself, a non-professional scientist to contemplate. It is startling to me as I recall my school-teaching about Euclidian geometry presented in such a rigid manner as to be unquestioned. Perhaps the presentation of Euclidian geometry as unquestioned reflected the nineteenth century attitude to science as having almost all knowledge.

By contrast, Bronowski continuing the discussion about Godel says "If a system is inconsistent, of course, we are well away because it can prove anything. But, unfortunately, it no longer distinguishes between true and false propositions. An inconsistent system is perfectly all right; it can prove the sentences that I can prove. But since it can prove anything, it is absolutely useless." (Bronowski, 1978, p78).
Bronowski illustrates the significance of his discussion by providing an anecdote attributed to Bertrand Russell. Bronowski tells the social background of Russell's discussion with a friend which I have omitted as not really relevant, preferring to go straight to Russell's example. Russell said "Oh it is useless talking about inconsistent things ... you can prove anything you like ...." Russell's friend said, " .... I want you to prove that you are the Pope" Russell responded "why, the Pope and I are two, but two equals one therefore the Pope and I are one." (Bronowski, 1978, p79).

 Appropriately, Bronowski says, "So it is useless to deal with inconsistent systems. Yet we have the fact that every closed formal system, if it is consistent, is not able to prove statements that I can prove standing outside the system ...... the reach of all formal systems is limited." (Bronowski, 1978, p79).

 Bronowski rounds out this part of his lecture by saying "It is the axiomatization, it is the formalization of the system that produces the trouble." (Bronowski, 1978, p80), and this opens the way for Bronowski to discuss the fundamentals of his epistemology already referred to, that knowledge is shaped by our self-referential participation.

 Putting this another way "Nature is not a gigantic formalisable system ...... no formal system embraces all the questions that can be asked ... truth is in many ways the problem. You can prove everything if you no longer distinguish between truth and falsehood .......

 This last statement is so obvious that it shocks me when I read it in print. It is not only epistemology, it is profoundly associated with social and political systems of the kind that can denigrate the dignity of humans. It is a passion of Bronowski that runs through his perceptions of poets as persons of universal, absolute, direct experience, and the ethical conduct of scientists.

 Bronowski goes on to develop the implications of the statement "You can prove anything if you no longer distinguish between truth and falsehood", and his elaboration leads into the climactic self-referential understanding of the limitations of axiomatic into formalized systems, I will quote what Bronowski
says: "But if you insist on truth and want to do it in an axiomatic system, then there are things you can show to be true, but which you cannot bring back to the formalism of the system. And if you then force them into the system, then you can show that something else is true, which in turn you have to force back in so that you have an endless regress of axioms that you have to add to all the time." (Bronowski, 1978, p81. My emphasis).

Bronowski then offers the position of "Gorgias of Leontium, Plato's least favourite sophist. Plato accused Gorgias of holding that there is no truth, if there were it could not be comprehended - and if comprehended, it could not be communicated. In some sense we have this feeling." (Bronowski, 1978, p81).

Gorgias' assertion has a delightful simplicity, yet is profoundly important to human intellectual activity. It is an act of creation with qualities of E Paul Torrance's characteristics of the creative person; and brings to my mind Bronowski's account of the child who disclaims that the amount of orange juice in a small broad beaker is the same, as in a tall slim beaker. There is no finality and no closed system, about Gorgias and E Paul Torrance's characteristics of the creative person.

To return to Bronowski, the key word in all that he is dealing with is communication (my emphasis).

Bronowski, once more, illustrates his point of view when he says, "But of course, we have it only if we ask that absolute systems be constructed which have no simple form. Now the question is, how did it all come about? Why do these theorems occur? And how is it that we are able to prove things to be true when they will not go into the system?" (Bronowski, 1978, p81).

Bronowski answers " ...... the problem which dogs all formal systems, the problem of self-reference ......" (Bronowski, 1978, p81).

Now Bronowski moves to the climax of this lecture, developing the self-referential issue. He offers self-referential knowledge as the means of dealing with the limitations of formal, axiomatic, systematic, organized self contained thinking.
The problems associated with the self-referential style goes back to the paradox of the liar or the paradox of Epimenides. Despite the reference to Epimenides, writers do not give a history of the person of Epimenides. I have made some enquiries and he was believed to be a sixth century BC Cretan seer, respected author of religious and poetical writings. Stories of his advanced age (157 or 299 years), his miraculous sleep of 57 years, and his wanderings outside the body have lead some scholars to regard him a legendary figure of the Shamanistic type (This information came from a conversation with a member of the Murdoch University Library).

Bronowski explains the paradox thus: "Epimenides the Cretan said 'All Cretans are liars'. And that is a statement which patently leaves you in a paradox. If all Cretans are liars, then what he is saying is not true. And therefore he is not a liar at that moment, and if on the other hand all Cretans are not liars, then what he is saying is true, and therefore all Cretans are liars." (Bronowski, 1978, p82).

Alongside Epimenedes, Bronowski relates Bertrand Russell’s exposition of this particular paradox ...... A contradiction essentially similar to that of Epimenedes can be created by giving a person a piece of paper on which is written 'the statement on the other side of this paper is false.' The person turns the paper over, and finds on the other side 'the statement on the other side of this paper is true.'" (Bronowski, 1978, p82).

Bronowski asks "Why is this a paradox? Because to use the phrase, 'the statement IS ' at once puts you into a universe of discourse in which you are no longer using this language to describe things, but statements about things. And now you cannot get out." (Bronowski, 1978, p83, my emphasis).

Bronowski reinforces the significance of the paradoxes by quoting from Alfred Tarski (1902 Poland-1983 USA), who had wide ranging interests in mathematical logic. "In 1931, Tarski proved quite simply that all this amounts to saying that there is no complete language of science. As soon as 'is true' enters a statement ...... you are landed in contradictions ...... like the Epimenedes paradox." (Bronowski, 1978, p83). So to say that something "is true" moves from
description to restrictive dogmatism, and thus is constrictive. This is my understanding of all that Bronowski has been concerned to demonstrate.

To say something "is" blocks our very right to talk about ourselves and the huge variety of things that we can imagine and do. Bronowski dramatizes the situation when he says "Nobody wants to talk in such a way as to be prevented from talking about themselves. Bless my soul! There would be universal silence. References to yourself are an essential part of our consciousness." (Bronowski, 1978, pp83-84). I presume this is what reduced Heisenberg and his colleagues in Nazi Germany. They were silenced on any physics outside the confines of what was specific to Nazi physics. In fact, is said that Heisenberg on one occasion talking to his students in Nazi Germany told them to disregard the fact that relativity was the outcome of the thinking of Einstein a Jew, and to study relativity. It is said that Himmler was going to move against Heisenberg but for the fact that a relative of Heisenberg knew a relative of Himmler and stopped him.

"Our humanity" asserts Bronowski "depends on both having in our consciousness a sense of self, and yet also knowing that inside every other person there is a self like ourselves." (Bronowski, 1978, p84). This is a fundamental belief of Bronowski and the basis of his epistemology. The interrelationship between people is shown in Bronowski's discussion of his love of literature, whether it be Yeats' For Anne Gregory, William Blake's poetry, obscure though it is at times, and is the key to Bronowski's oft repeated statement that acts of creation whether they be by the artist or the scientist depend upon people accepting each other with inner sensitivity. I respond to the poetry of Sir Philip Sidney in this way, especially My True Love Hath my Hart and O Sweet Woods.

Returning to science, Bronowski again reviews Godel, Turing, and Tarski, and says that despite the need to say "is" in a statement in science, and the difficulties that are involved, "we go on doing science in the same mechanistic way because that is the one strategy by which we make progress ......" (Bronowski, 1978, p85).
Bronowski continued to affirm the mechanistic way of doing science, with the limitations demonstrated by Turing's machine, Godel's and Tarski's illustrations of mechanistic limitations. Bronowski said he gave a talk previously "not unlike this one, one of my listeners was Pauling." (1901-1992) "Pauling got very impatient toward the end of the talk and said to me, 'Tell me one operational way in which what you are saying would make me do science differently.' To which the answer is 'No, we know no other way of doing science.'" (Bronowski, 1978, pp 85 - 86). Linus Pauling was awarded the Nobel Peace Prize for his efforts on behalf of a nuclear test ban treaty, and a Nobel Prize for his work on molecular chemistry.

Fig 5.13 Linus Pauling

I can understand Pauling's impatience, because so much that Bronowski himself has said and written in lecture 4 confirms his reply to Pauling - "we know no other way" because we are self referential in our outlook in a Talmudic, totally connected universe. As Bronowski acknowledges, "We have to realize that the total connectivity of Nature is something that cannot be imagined in axiomatic systems. To that extent, no propositions that we put, no axiomatic system, no formal language is ever final." (Bronowski, 1978, p86).

It reminds me when I was a schoolboy that despite in one lesson, we learned that Euclid said 'parallel lines never meet' or 'a point has position but no magnitude', while the next lesson would be English or French or Latin with all the variations in the language being human, because English or French or Latin are self referential.

Bronowski expresses this well, when he says: "As soon as the system" (in science) "runs into a fault, into an inconsistency, the human mind unlike the
machine, has the ability to throw the whole thing away and start building up a new axiomatic system ...... general relativity has taken the place of Newton's system, and no doubt something else will take the place of general relativity" (Bronowski, 1978, p87).

What Bronowski regards as so important for humans despite pursuing the mechanistic way is their "optimism," one of his passions, expressed in the very title of his last endeavour, The Ascent of Man.

Bronowski concludes lecture 4 by conveying his belief that axioms are quite in order in our thinking and organizing, if the axioms help to show "the connections in nature, not because they do in fact show the connections in nature but because they are coming closest to it." (Bronowski, 1978, p89) This is another way of Bronowski giving his epistemology.

It is as though having struggled through the anxieties and doubts about human generativity that seemed associated with Epimedes, Russell, Hilbert, Godel, Turring and Tarski, all is forgiven! We can just go on with our work optimistically, with vision and imagination to generate knowledge.

5.3.5 Lecture 5

Error, Progress and the Concept of Time.

The Silliman Lectures continued when Bronowski delivered lecture 5 entitled Error Progress and the Concept of Time a week later. He uses the first part of the lecture to review the four lectures which have gone before, reminding his audience that this aim throughout "was to put into practice the philosophic project that Immanuel Kant once set himself - how is man's view of the world dictated by his biological makeup." (Bronowski, 1978, p93).

I wish to begin the account of lecture 5 with a short overview of the meaning of the title, because seemingly the three words error, progress, and time are not especially connected. But they do form another facet of Bronowski's epistemology. We need errors to make progress whether in science, poetry, painting, medicine, to name but a few topics. It takes time for errors to occur, and to be recognized as good or bad errors and learned from. Accepting errors,
progress and time, the human being using his brain, nerves and muscles, moves away from taped digital machines. In the essays The Visionary Eye, published in 1978, Bronowski discusses how errors, progress, and time, are an essential part of technology and design in such everyday matters as architectural planning, men and women's clothes, and much more. I will come to this issue later in chapter 6.

The reference I have made to taped, digital machines provides an appropriate opportunity to go back to review lecture 1. Bronowski says "In the first lecture I talked particularly about how the senses enter our consciousness ....... when we look at what the eye does we become aware that it interprets the world from the outset by a process of inference. Perception itself is a mechanism in which sensations are instantly interpreted by an inferential process ....... vision is one of the two main gifts and privileges that man has ....... In the second lecture the emphasis is on the second of these gifts, the gift of speech ....... Vision is our channel to the outside world, speech is our channel of communication with one another." (Bronowski, 1978, pp91-92). Some of this material is discussed in The Identity of Man when Bronowski says "Our consciousness of the world is thing-directed and action-directed because that is how we ourselves speak. With consciousness comes self consciousness. We think of ourselves also as objects. And all the paradoxes of science and literature arise from our attempts to speak simultaneously of ourselves both as knowing selves and as known objects." (Bronowski, 1978, p95).

It is the acceptance of ourselves as known objects that is of "cardinal importance" (Bronowski, 1978, p95). Bronowski summarizes the third and fourth lectures: "I presented a view of science as the process of taking the sentences of explanation of how the world speaks and breaking them into words ....... 'gravitation' and 'electron' ....... are just as much inventions as the words 'tree' and 'love' (Bronowski, 1978, p95). Bronowski reminded his audience that "There is no permanence to scientific concepts (relativity replaces gravitation, oxidation reaction replacing phlogisation) because they are only our interpretations of natural phenomena. Why are they only provisional? Because - and this was the central point of my third lecture - the part of the world that we can inspect and analyse is always finite ....... Whatever explanation we invent at any moment is a
partial connection, and its richness derives from the richness of such connections as we are able to make." (Bronowski, 1978, pp96-97).

The richness of connections is related to all the issues of self referential outlook from ourselves which come from fenced off areas of enquiry. These areas are considered by the Talmudic whole of the universe and Nicholas of Cusa's beliefs. Bronowski goes on from the richness of ideas to say: "Now in order to establish this in the most direct terms I devoted my fourth lecture to really a rather difficult subject (which I am happy to be talking about now because even ten years ago it was very hard to get anybody but professional mathematicians to listen to it) the fact that mathematical systems suffer from the same partiality." (Bronowski, 1978, p97).

Bronowski begins lecture 5 by again reviewing the work of Godel, Turing, and Tarski, with Tarski summarizing the partiality of mathematical systems in science by saying, "No universal language for all of science can exist in all cases without paradox." (Bronowski, 1978, p97). Bronowski opens out the fifth lecture by saying "Only the human mind can transcend all the machines. Why? Because the human mind is not a digital computer." (Bronowski, 1978, p98). He elevates the idea of self reference when he says "Self-reference like self-consciousness is in fact, the glory of the human mind ....." (Bronowski, 1978, p98). In effect, if we try to remove the imagination, the personal thinking language from a system, we make a system which doesn't think.

The second point which Bronowski makes is that Tarski argued "As soon as you introduce the phrase 'so and so is true' then the words 'is true' create self reference in the language which gives rise to the paradoxes. As Bronowski says "You cannot do without 'is true' ...... it is of the nature of cognitive construction of human language that these contradictions occur in it. Now we might naturally ask 'well what about the brain? How does the brain cope with all this? ...... Where does the brain fail to be bound by these uncertainties and paradoxes?" (Bronowski, 1978, pp98-99).

Broadly the answer is that the brain as discussed earlier in the thesis, is not a box by itself, it is part of the whole body. It is connected by nerves and muscles to self
reference outside ourselves and via the senses of vision and hearing, so ambiguity is a basic fact of human activity. Bronowski puts this explanation in a more detailed way by demonstrating ambiguity as a characteristic of human activity, which I believe gives authenticity to *The Face of Violence*. Bronowski says "You just have to face the fact that the totality of mind and body forms a unit in which the mind is not a finite system." (Bronowski, 1978, p101). Further he comments: "And that goes for psychology, it goes for literature and the striking thing is that it goes for mathematics and science." (Bronowski, 1978, p98).

Bronowski gives such repetitive emphasis to these issues because he regards them as the foundation of epistemology. He amplifies the meaning of the word ambiguity, ie, never a finite closed off reaction of human thinking, using Werner Heisenberg's Indeterminacy Principle to illustrate these issues.

Bronowski says, "Heisenberg's paradox about why you cannot measure the momentum and the position of the particles simultaneously ......" (is) "Because you are challenging the particle to print two symbols at the same time ...... It is not bound by its nature to print two symbols ...... that is not its reality." (Bronowski, 1978, p102).

While lectures three and four put much emphasis on intellectual discussion of mathematics and science and the limitations from the paradox 'is true', it is important to remember "that I am going to be talking about epistemology and you cannot see the world without the intervention of the physical senses." (Bronowski, 1978, pp4-6).

![Fig 5.14 Werner Heisenberg.](image)
It is appropriate therefore, after discussing the Heisenberg paradox, that Bronowski turns to research on the brain saying "...what is so exciting about research on the brain at this moment is that although we do not know, we can see how it must go. It is clear that the mind can get this enormous richness because it has a huge number of connections ... the brain must be using some kind of statistical language which is quite unlike human language." (Bronowski, 1978, p103).

Bronowski refers to John von Neumann who in a Silliman lecture, perhaps in 1965, "... pointed out that there were good grounds merely in terms of electrical analysis to show that the mind, the brain itself, could not be working on a digital system ...there is a statistical language in the brain, it is different from any statistical language that we use, we do not know how it goes, but this is what we have to discover." (Bronowski, 1978, p103).

The implications of what Bronowski says about the statistical connections means that ....... "Ambiguity, multivalence, the fact that language simply cannot be regarded as a clear and final exposition of what it says, is central to both science, and of course literature." (Bronowski, 1978, p 106). Bronowski says earlier "... the number of connections within the brain - the number ...... is certainly of the order of ten to at least the tenth or the eleventh." (Bronowski, 1978, p105).

Remembering the title of this lecture Bronowski puts the previous discussion in another way. He says "Most of human sentences are in fact aimed at getting rid of the ambiguity which you unfortunately left trailing in the last sentence." (Bronowski, 1978, p107).

In Yeats' poem For Anne Gregory at the start of lecture one, the young man says to Anne that despite the fact that she could change the colour of her hair, only God could love her for herself alone; the colour of her hair must influence the young man. Statistical connections in the brain must influence how the young man sees her.

At this point in the discussion I must deviate from Bronowski's own thinking to consider Bronowski himself, Bronowski the man who illustrated that ambiguity
is the essence of human creativity. First of all, I will repeat what he said following his comments on the number of statistical connections in the brain. He said "Ambiguity, multivalence, the fact that language cannot be regarded as a clear and final exposition of what it says, both to science and, of course to literature." (Bronowski, 1978, p106).

As I mentioned earlier in the thesis, when at Cambridge majoring in mathematics with a special interest in topology, Bronowski also edited a literary journal Experiment. As well, he recalled seeing the poet WB Yeats and the scientist Albert Einstein standing side by side to receive Honorary Doctorates at the University.

Then, not long after, in 1939, Bronowski wrote The Poet's Defence the subject of chapter 2, to allow the poets from Sir Philip Sidney to WB Yeats to speak for themselves, to draw upon their own inner, unique experiences. At the same time, Bronowski was lecturing on mathematics at University College at Hull, before moving into wartime activities culminating as Scientific Deputy to the British Chiefs of Staff mission to Nagasaki.

Then Bronowski wrote The Face of Violence a powerful study in various persons' reactions to behaviour at the fictional Bosscamp, contrasting the ambiguity of violence with forgiveness:

Violence has a human face
Forgive the man his violence

Not long after, a series of lectures were given by Bronowski to the MIT and published as Science and Human Values; again the ambiguity of science and human values being contrasted with the The Identity of Man; and then on to this chapter where The Face of Violence ambiguously contrasted with The Origins of Knowledge and Imagination especially concerned to contrast axiomatic formalized, 'is true' studies with the ambiguity of knowledge in Heisenberg's Indeterminacy Principle. Perhaps the most powerful of all of Bronowski's studies in ambiguity in science, technology and poetic integrity, together with visionary perceptions is his absorbing intense study William Blake and the Age of
Revolution. Cotton mills, iron mills, mining, money making by the Whigs, set against the integrity of the man William Blake.

George Derfer in his 1974 interview with Bronowski summed up Bronowski's creativity when he said "... In your life I have never seen you separate poetry and science as most people seem to ..." (Derfer, 1974, p394). I quote Derfer once more because when he links poetry and science in Bronowski's life's work, he is acknowledging Bronowski's creativity, when Bronowski links two seemingly unalike activities, science and poetry, into one likeness, the actions of a human being as a unity then there is, a fundamental statement of Bronowski's epistemology.

I very much wanted to review Bronowski's own creativity in presenting two unalike facets of human life: poetry and its open ended ambiguity; and my own reactions in struggling to understand the work of Godel, Turing, and Tarski, who are in such contrast to humans expressing themselves in the practice of clinical psychology of the logical positivists, behaviourist style. Bronowski's work has opened out my own perceptions of ambiguity.

Now to return to Bronowski's lecture 5, as he approaches the conclusion of "Error, Progress and the Concept of Time. He again takes up a consideration of science relative to the formalism that has gone before. He says "Science is an attempt to represent the known world as a closed system with a perfect formalism. Scientific discovery is a constant maverick process of breaking out at the ends of the system and opening it up again and then hastily closing it after you have done your particular piece of work. ....... it is in the nature of all symbolic systems that they can only remain closed so long as you attempt to say nothing with them which was not always contained in all the experimental work you had already done ....... Well, neither biology, nor physics, nor chemistry, nor any other subject is like that." (Bronowski, 1978, p108).

While it seems that Bronowski is repeating himself with that statement - I have quoted him in various parts of the thesis - he goes on to present the idea with a somewhat broader expression; "what distinguishes science is that it is a systematic attempt to establish closed systems one after another. But all
fundamental scientific discovery opens the system again. The symbolism of the language had been found to be richer than had been supposed. New connections are discovered. The symbolism has to be broadened. Symbolism, language, scientific formulae here are all synonymous." As Bronowski has noted before $G = k \frac{m_1 m_2}{r^2}$ is language as much as 'a robin redbreast in a cage'. Bronowski enquires "What opens it? That function of the brain which in fact is not the function of a digital computer." (Bronowski, 1978, p109).

I wonder whether Bronowski is being very generous to many scientists here, despite the democratic, ethical community of scientists which he discussed in *Science and Human Values*. I wonder whether many scientists, female as much as male, go to their laboratories or lecture rooms each day much like a digital computer with a taped programme.

Bronowski does elaborate his question: "What opens it? (the symbolism) ... an inconsistency in the system, then you reorganize the whole thing. And that reorganization is a central act of imagination." (Bronowski, 1978, p109). He instances the Michelson Morley experiments which upset Newtonian absolutism.

Although Bronowski doesn't say so, I presume that he is referring to the development of Einsteinian relativity and space-time dimensions over Newtonian absolutism.

Bronowski continues to develop the epistemology that the act of imagination is the opening of the system so that it shows new connections, and he acknowledges that the seeking of likenesses among the seeming unalike was the epistemology that he earlier explained in *Science and Human Values*. Although he doesn't say so, such activity as seeking the unalikes must take courage as much as recognizing the likeness. Abraham Maslow's paper *The Need to Know and the Fear of Knowing* which I discussed in an earlier chapter, deals with the courage. Only as I have pondered these issues once more as I work through lecture 5, have I recognized courage is needed in the arts - a new style of painting, a new poem, or the courage needed by a client in psychotherapy or counselling to let himself or herself recognize facets of their lifestyle and integrate them to enhance their wellbeing. In *The Visionary Eye* which I plan to consider in chapter 7, Bronowski
pays much attention to the processes in the development of painting, poetry, literature, music and architecture.

Bronowski having opened up the topics of errors, good and bad errors, and progress, turns his attention to time. He says that he had intended to look at time as understood "through successive generations" (p 110), but he decided to reduce that plan to "one point that I want to pick out. In my concept of time, the notion that errors are made by nature, that replication is not perfect, is central. Evolution is built up by the perpetuation of errors. It runs counter to the second law of thermodynamics by promoting the error to a new norm so that the second law now works on the error, and then a new error is built up. That is also central to all inductive acts and all acts of imagination." (Bronowski, 1978, p110). The second law of thermodynamics states that heat cannot be transferred by any continuous, self sustaining process from a colder to a hotter body; the entropy of a closed system increases with time. (Uvorov et al, p425).

Bronowski explains what he means by asking "Why does one chess player play better than another? ...... in a fundamental way the one who plays better makes more mistakes, by which I mean more imaginative mistakes. He sees more ridiculous alternatives. ...... His choice does not conform to the way in which ...... a machine would play the game." (Bronowski, 1978, p111).

Bronowski's explanation here has the quality of courage in creative imagination, perhaps derived from his mathematical experiences. Thinking back to his wife Rita's interest in the titles of his research papers and Bronowski's account of the thinking of Godel, Tarski, and Turing, it seems to me that pure mathematics is called pure because it emerges from the inner self in the same way that poetry, or for that matter other facets of the arts emerge from inner experience.

In keeping with his thinking about errors, Bronowski goes on to say " ...... all imaginative inventions are to some extent errors with respect to the norm. Nothing is worth doing which is not this maverick kind of change." (Bronowski, 1978, p111).
This is a fascinating idea. Following Bronowski and my own comments, two examples of maverick personalities come to mind - William Blake's poetical observations on the plight of the iron mill workers from *Vala and the Four Zoas* quoted in chapter 4; and the music by Igor Stravinsky written early in the twentieth century. His music for the ballet *The Rite of Spring* expresses the force of regeneration of animal and plant life in the Spring, while Blake tells of the workers labouring pitifully amongst the hot ashes of the iron mills.

Applying his thinking on errors, which "have the peculiar quality of being able to sustain themselves, of being able to reproduce themselves," Bronowski says, "...... more scientific theories are wrong than right ...... because that is the nature of looking for imaginative likenesses. You are always looking for a likeness and nine out of ten of the likenesses you are looking for are not there ...... more bad science is produced than good and more bad works of art are produced than good ones." (Bronowski, 1978, p112).

Bronowski makes an astute comment when he says "The difference is only that most scientists take care not to exhibit their bad work" (Bronowski, 1978, p112). I would think this contributes to the mystique of science as an activity done by the bespectacled white coated persons separated from the daily life of the community. I suspect that the separation of science and the humanities about which Bronowski was aware in his days as an undergraduate at Cambridge, is still the case in universities and research institutions in the beginning of the twenty-first century. What does this say for all the effort Bronowski put into his work to bring science and the arts together? I explore this issue in the next chapter.

Bronowski concludes lecture five by referring to "Progress is the exploration of our own error. Evolution is a consolidation of what has always begun as errors ........ errors that turn out to be true and errors that turn out to be false (which are most of them). But they both have the same character of being an imaginative speculation." (Bronowski, 1978, p112).
Bronowski refers to the "human side of discovery and progress" (p112) in which he says that this is so important to say "in an age in which most non-scientists are feeling a kind of loss of nerve." (Bronowski, 1978, p112).

This is just what I referred to as science having a mystic quality among the general population, because the bad errors are not known to the ordinary man and woman.

Errors are most important because they allow progress. A preparedness to tolerate errors, to regard them as part of progress, as part of self-referential behaviour makes science as well as arts a "constant adventure", and of course answers Bronowski's question "Why do we know more now than we knew ten thousand years ago, or even ten years ago?" (Bronowski, 1978, p113). Bronowski's reference to "the preparedness to tolerate errors, to regard them as a part of progress" correlates with E Paul Torrance's characterization of the creative personality.

This is another facet of Bronowski's epistemology, and another expression of his optimism about the ascent of human beings. Bronowski finishes lecture five by reminding his audience that we should also know something of the laws and responsibilities by which ..... investigation is bounded. He concludes by saying "My sixth and last lecture will deal with this. It is called Law and Individual Responsibility." By the word 'law' Bronowski means ..... "state law." (Bronowski, 1978, p113).

5.3.6 Lecture 6

Law and Individual Responsibility

Compared with the previous five lectures, lecture six is rather a loosely linked account of the individuality of the scientist, the community of scientists, the "place of science in our society today, not as a technical activity, not even as a search for knowledge, but as the kind of ethical activity it is." (Bronowski, 1978, p117). Despite my observation on the loosely linked nature of lecture six, Bronowski goes on to say "When I gave this lecture its title, it was because I wanted to talk very clearly about the ethical conditions which have made the practice of science successful, and indeed possible." (Bronowski. 1978, p117).
If this last comment of Bronowski has a familiar ring, it is because he himself says that the basis of lecture six follows his earlier work *Science and Human Values*.

Referring to the scientist as a person, Bronowski reminds his audience "In the fourth of my lectures I told you a story about Linus Pauling. I said that I had given a talk to a small group of scientists roughly on the lines of that lecture, namely, about the limitations inherent in all axiomatic scientific systems ...... as I came near the end of the lecture, Pauling became more and more restless, and how, as soon as I had finished he said to me, "Operationally speaking, as a practicing scientist, how does all this affect me. How should my practice as a scientist be changed by the fact that you tell me convincingly that mechanism is not the answer to the world as it is put together?" (Bronowski, 1978, pp117-118).

Bronowski replied "'And I said blandly and sweetly, not at all. What we have really proved is that mechanism is not an ultimate explanation of the world, but it is the only strategy that we know for penetrating the laws. And you go right on doing it' ...... then Pauling said to me 'OK, why should I care? Why bother me with all this abstruse stuff about how the world is really put together?'" (Bronowski, 1978, p118).

Bronowski continues "So I said on this occasion to Pauling 'well that is a very strange thing for you to say because you of all people are a man who has demonstrated that a scientist is not merely a man who makes profound imaginative discoveries, but a man who regards the world as a whole. Here you are, the only man in the world who has actually won two Nobel Prizes, one for chemistry and the other for what? - for peace, if you please. And you ask me why the change in the world picture of science should affect scientists. You, Pauling, are the personal demonstration of the fact that a scientist is a complete person and that he can no more talk about chemistry without thinking about peace, than he can talk about peace without thinking about chemistry'. Now I am happy to say that Pauling said absolutely nothing in reply." (Bronowski, 1978, pp118-119).

Before I proceed further with Bronowski's lecture, I must relate my own reaction to Linus Pauling's personal history. I recently read his biography, a short version,
and he was indeed a complete man. He was born in 1901 in Portland, Oregon, USA, into a family "at the edges of poverty." His biographer traces Pauling's remarkable intellectual journey through various US institutions mainly staying with the California Institute of Technology. ...... "Pauling was criticized for using too large an amount of intuition in his work and not always having complete data to back up what he wrote." Pauling often came into personal argument and conflict with other scientists such as WL Bragg in London. "In 1954 Linus Pauling was given the Nobel Prize for chemistry for his work on molecular structure especially proteins."

Pauling and his wife Ava Helen (nee Miller) became political activists, "particularly his protesting of atomic bomb testing. This culminated in a petition to the United Nations - signed by eleven thousand and twenty-one scientists around the world - calling for an immediate world wide ban on nuclear testing". Despite his troubles with the US authorities over his political agitation, "On October 10 1962, it was announced that Linus Pauling had been awarded the Nobel Peace Prize for his efforts on behalf of a nuclear test ban treaty."

To conclude this outline of Pauling's life, he was once asked by a high school student "How can I have great ideas?" Pauling's answer was "The important thing is to have many ideas." His biographer concluded, "He certainly followed his own advice." (Linus Pauling, a Biography, 1992)

I have given this brief account of some of the aspects of Pauling's life because he so well illustrates Bronowski's belief that "scientists are maverick personalities." (Bronowski, 1978, p119). Such persons are indeed, rare exciting people. Men like Pauling show what E Paul Torrance meant by the creative personality, and they illustrate too Abraham Maslow's conception of transcendence.

The discussion of Linus Pauling and his wife is also significant because it draws attention to the fact that Bronowski in his writings rarely referred specifically to women, but he does so in the Silliman Lectures of 1967. He said "one of the reasons why, on the whole, women have had difficulty so far in making very good scientists is that they are not contrary enough. Happily time will cure all that. Time will produce belligerent, contrary, questioning, challenging women, as
it has produced, belligerent, contrary, questioning, challenging men." (Bronowski, 1978, p120).

Since I am writing this chapter of the thesis in 2000-2001, it would be an interesting study in itself to follow up Bronowski’s prediction, but of course, I cannot do that here.

Still on the topic of individuality of scientists, Bronowski repeats his oft said observation "The scientist is as completely involved in the whole of his work as any poet or artist, and I suppose bank manager or truck driver." (Bronowski, 1978, p121). What he had to say which gives meaning to that observation about scientists, bank managers, and truck drivers, is a view held by Abraham Maslow, that it is not the work a person does which gives meaning of his life, it is the value the person places on himself doing the work. A good carpenter who takes dignity from his labour can hold himself as highly as the good surgeon who incises with care. William Blake and William Wordsworth, each in their own way, expressed the same view about the dignity of labour.

Bronowski moves on "Now to the community of scientists. ....... what has made science successful as a social leaven over the last three hundred years is its change from the practice of individuals, however great their ingenuity, to a communal enterprise." (Bronowski, 1978, p122). To support his argument about the productive and social power of scientific activity and knowledge, Bronowski instances the experience of "Leonardo da Vinci" (who) "was born in 1452. He died in 1519. No scientific society existed at that time; no Shakespeare, no Galileo had yet been born. And one reason why immensely prolific, vivid, imaginative, and inventive brains like Leonardo failed to make any direct impact on the body of science was that there were no colleagues ....... even that tremendous mind could not work in isolation." (Bronowski, 1978, p123). I would support Bronowski’s views here; even the active, imaginative Linus Pauling worked in a community of scientists. E Paul Torrance recognizes this feature when he reminds the creative personality not to withdraw into isolation but to maintain the integrity of his own personality and work in society.
Bronowski himself, a creative person, always worked in society in England and America. While it would be extravagant to compare him with Leonardo, I wonder, because of his uniqueness, what influence Bronowski has left on the arts and science since the years following his death in 1974. This was considered by George Derfer, who said "I am fascinated by what you are saying, which leads me to say that in your life I have not seen you separate poetry from science as most people seem to" (Derfer, 1974, p 394). This important matter I give attention to in chapter six.

Now to return to Bronowski's own discussion in lecture 6. He moves from the scientist as individual to review the topic that "science is and can be practised as a communal activity." (Bronowski, 1978, p124). He goes on to contrast the strength and high levels of productivity evidenced by the "list of people who since 1900 have won the Nobel Prizes in physics, biology, and medicine, chemistry, there is hardly a name you would not recognize and respect. But, alas, if you look at the list of people who have won the Nobel Prize for literature during the sixty odd years it has been awarded, it really makes rather sad reading" (Bronowski, 1978, p124).

Bronowski says "When I was a boy the Nobel Prize for literature was awarded one year to a lady called Selma Lagerlof ...... Clearly there is much more uncertainty in the awarding of literary prizes." (Bronowski, 1978, p124).

Of course, the uncertainty in literature, and I believe too in music and painting, is explained by Bronowski himself. The uncertainty relates to the ambiguity in the arts. An example is the conclusion to The Face of Violence. The topic of knowledge in the arts will be considered further in chapter six. In the context of the present discussion, literature aims to open the reader to consider him or herself and to ponder other people as a continued enhancement of the person of the reader. I think Bronowski does an injustice to the aims of literature to compare it with science in the awarding of Nobel Prizes. He has often said that science tries to close down and remove ambiguity from its findings, even though it goes through stages of changes involving the opening out of knowledge, and the closing down point when a specific goal has been reached, would make it easier to assess its distinctiveness for the purpose of Nobel Prize awarding.
"Literature aims to open and stay open the experiences of writer and reader, and, by Bronowski's own considerations, it is therefore more difficult to assess its value as "is" and "ought" because it is based on inner experiences."

Selma Lagerlöf (1858-1940), in 1904 was the first woman and also the first Swedish writer to win the Nobel Prize for literature.

Bronowski pursues this interesting matter of the awarding of Nobel Prizes, when he points out (it) "has nothing to with whether scientists are being better judges of whether literary critics are good or bad. It has to do with the fact that in the practice of science everybody knows what everybody else's work is. How has this been possible? Of course, it is very simple. In the end you cannot propose a scientific theory unless it conforms to certain sanctions of fact. Now, it is true of literature, it is true of painting, that it has to conform to some sanctions of how human beings think and feel and act, but such sanctions are not as easily exhibited as the physical facts of science." (Bronowski, 1978, p125). This relates to my comment at the end of the previous chapter. Bronowski continues "If I write a paper and it goes to China and Czechoslovakia and South America and Los Angeles everybody in all these places who reads it believes that I am telling the truth as I see it. Nobody assumes that what I am saying is true. It is not given to us to know what is true in that sense but everybody knows that I write the scientific paper on an implicit unwritten understanding among scientists that it can be absolutely believed to be what I believe." (Bronowski, 1978, p125).
I would like to give some examples from personal experiences which parallel Bronowski's example of truth as he sees it. I went to an exhibition of the paintings of the highly regarded Australian artist, Arthur Boyd. There were a considerable number of paintings in the gallery, and I still recall the authenticity and power of one of the works depicting a man in a wheelchair being pushed along by another man. The wheelchair patient had a look of anguish on his face which was surely genuine as the artist portrayed it.

I make this comment about Arthur Boyd's integrity because I recalled a young woman in the spinal injuries unit of Royal Perth Hospital who was referred to me in my capacity as clinical psychologist. The young woman, a school teacher, had been in a car accident, and I was asked to assess her as to her future intellectual and personality stability for work. When she was wheeled into my consulting room she appeared as a pretty blonde haired young woman in her early twenties, but with an emotionally empty face. There was no doubt as I saw her about the authenticity of the personal damage done to her body and her psyche. She made Arthur Boyd's painting authentic to me.

Just to round off this area of discussion, I will refer again to an example I gave in chapter four on the impact on me of a performance of Beethoven's Choral Symphony. What Beethoven was saying about the brotherhood of man was so real to me, I had the distinct impression that he was sitting in the Perth Concert Hall listening to the orchestra's performance of his work.

When I recall these episodes I am also aware of closeness to Bronowski, the man himself, as I have come to understand the remarkable unity of poetry and science and human specificity in his work which was recognized by George Derfer. I have come too to recognize that my appreciation of Bronowski, of Arthur Boyd, the young woman in the wheelchair, of the Beethoven symphony is linked in myself, as a clinical psychologist, and to the personal response I could feel to the work of the Third Force psychologists such as Abraham Maslow. Abraham Maslow's conception of the self actualizing person stimulated me to understand the humaneness of the quantum physicist Niels Bohr, about whom I wrote in my dissertation in 1993.
Were more persons interested in the humanities given appropriate and intensive training in topics such as creativity, in aspects of clinical psychology such as the development of the adult personality to the level of the self-actualising person, then one could hope for stronger basis for the understanding the qualities appropriate for Nobel Prize awards in literature, music, and the arts. There would be a closer relationship between awards for science and the arts that would match Bronowski’s oft stated belief that science and poetry are closely related. This would mean that there would be less emphasis on awards in science compared with the arts, and less likely to be “loss of nerve” in the community. This issue of trying to bring science and arts closer together for Nobel Prize assessment I referred to earlier.

To return to Bronowski’s lecture 6: the subject of ethical responsibility is taken further, and as he has done on previous occasions, the 'is' and 'ought' issues in scientific enquiry are dealt with. Bronowski is clear in his belief that "It is basic to the concept of truth as practised in science that it is an absolute considered in every detail. There is no distinction between good means and good ends. You are only allowed to employ perfectly honest means. This is what puts you in a position of special trust. And this is a deeply ethical principle." (Bronowski, 1978, p127).

Bronowski presents his belief "that you cannot know what is true unless you behave in certain ways. What is the good of talking about what is, when in fact you are told how to behave in order to discover what is true. 'Ought' is dictated by 'is' in the actual enquiry for knowledge. Knowledge cannot be gained unless you behave in certain ways." (Bronowski, 1978, p129). Bronowski gives the practical example of the Nazi scientists and he presents "their dilemma. On the one hand they were addicted to the founding principle of the modern state, which is that knowledge brings you power, and on the other hand they were not willing to accept the fact that you can only gain knowledge by being truthful ...... A basic reason why no discovery of importance was made by the Nazis throughout the war ...... was because Nazi scientists were caught up in a dreadful paradox; they only knew one way to get knowledge, but that was exactly the way that was forbidden." (Bronowski, 1978, p130).
Bronowski instances the situation which I have mentioned previously "When Heisenberg was actually foolish or courageous enough to give a speech to his students saying 'you must read relativity, never mind whether Einstein was a Jew or not'". Himmler had Heisenberg investigated but the matter was not pursued. There is an irony in this situation because in the late 1920's, Heisenberg, the young man working at Niels Bohr's Copenhagen Institute enjoyed the freedom to think through the Principle of Indeterminacy. There is another irony in that Bronowski himself, in The Ascent of Man, uses Heisenberg's Principle but names it the Principle of Tolerance.

It comes down to the belief "You cannot make the simplest statement in science without having to believe in a lot of people" comments Bronowski. He goes on "I know an awful lot of biologists and there are many subjects about which I would not believe a word they said. But when they start talking about how DNA is put together, then I know they are telling me the truth. We could not work without that tradition, it started back in 1660 when scientific papers really began as personal letters from one friend to another. That has been the quickening life force in science which has made it possible for people to have absolute trust in one another's statements." (Bronowski, 1978, p131).

Bronowski then turns to other values which derive from truth, again reminding his Silliman audience that he considered these values in Science and Human Values. Values which Bronowski lists are the personal values - respect, sensitivity, tolerance - without which science could not be carried on. They are the 'is' values, the values of man working by himself. And then there are the communal values, the 'ought' values - honesty, integrity, dignity, authenticity, which bind the scientific community together." (Bronowski, 1978, p132). The need for both the 'is' and 'ought' values have been demonstrated by Bronowski's consideration of scientists, especially showing how the failure to acknowledge them affected Heisenberg, confined under the Nazi regime. After WWII Bohr and Heisenberg were unable to redevelop their pre-war relationship. History has it that Bohr wrote a 'stern' letter to Heisenberg but did not send it.
Bronowski asserts that on the basis of these 'is' and 'ought' values, science has been able for three hundred years to change completely .......... practically every fifty years. (Bronowski, 1978, p132).

An example which is obvious to me is the change from the absolutism of Newton to the relativity of Einstein, and Newton is not thought the less of because of the change. Patrick Blackett, whose theory that magnetism was due to rotation, did not work, did not prevent him being elected President of the Royal Society. The societies which do not allow their scientists, and their intellectuals and poets, artists, and musicians to experience the 'is' and 'ought' values, perish. Bronowski instances the decline of the systems of Hitler, Mussolini and Stalin which died.

To round out the variety of considerations in lecture six, indeed in all six lectures, Bronowski said that he would be timid not to say something about the impact of this aspect of science into our society. We are living for the first time in what is essentially a community penetrated through and through by the scientific outlook which is inseparable from the scientific ethic. (Bronowski, 1978, p133).

Outlook and ethic could well be the passions, beliefs, and values of Jacob Bronowski, as he continues to emphasize the communal infusion of the scientific ethic, saying "We are living at the moment in history when the scientific ethic comes through everything." (Bronowski, 1978, p134).

He elaborates the implications by the quite serious statement "I think that at present there is quite a crisis in the history of politics and government. I think that it is a very difficult time to have governments run by people who are really too old to have quite this spirit." (Bronowski, 1978, p134). Bronowski considers that there is not just, what he describes as a "credibility gap" but that "intellectuals" and those who grow up in the "hallowed halls of universities" consider it is a "hypocrisy gap" (Bronowski, 1978, pp134-5). What troubles Bronowski is that he has seen the law as practised by society.

Put in another way, "the whole relation between 'the law of nature' and 'the law of man' between 'is' and 'ought' is lost (Bronowski, 1978, p135). This is an immensely important value issue which runs through all Bronowski's thinking, as
he says when he comes to what I consider is a belief, rather more a profound conviction, which has motivated him since childhood, in Poland, and in Germany, before he and his family moved to England. He says "Democracy is a way of organizing the state which has shown success exactly as a science has because it is constantly able to transform itself. It can only do that by the same means as science, by absolute honesty and integrity. And my personal dictum about all politics is this: just make sure that everybody tells the truth all the time and tell him when he is not. You will be surprised how much notice people pay." (Bronowski, 1978, p136). These beliefs are as valid today as when Bronowski voiced them in 1967.

Among his closing statements to lecture 6, Bronowski says, "Certainly the intellectual's duty to complete integrity seems to me clear-cut. It seems to me clear-cut that we do not want to argue about whether these are good ends or those are good ends, whether such and such or such and such is a good form of society. We want to argue about the fact that as intellectuals we have seen the prodigious success of science as an activity because it is based on perfect trust in the truth of statements. The intellectual as a witness to truth seems to me the one thing that has to come out of this. And if I have spent five earlier lectures confusing you a great deal about just what the truth is, do not be alarmed. It is exactly because we know that we are not guardians of the truth, we do not hold any Holy Grail, that we tell the truth as best we can, and stick to that through thick and thin." (Bronowski, 1978, p137).

Bronowski's view about "perfect trust in the truth" of scientific statements may be regarded as innocent by many scientists today in view of their experience of falsification or misreporting of results.

With that proclamation of Bronowski's I end chapter five, knowing that Bronowski speaks from the heart, just as Clarissa spoke from her heart on appealing to Mark and Crump for compassion as a way of understanding human affairs.

As I think back over this chapter, the two expressions that I recall which unite the work are “compassion” and “democracy of the human intellect.” As always,
Bronowski is concerned to maintain the social-solitary aspects of each human. These features are communicated by the expression of compassion which unifies *The Face of Violence* and "democracy of the human intellect" which unifies *The Origins of Knowledge and Imagination*. Overall, these 2 expressions "compassion" and "democracy of the intellect" mean a whole person integrated in mind and body. With such integration, there is optimism and tolerance, so although "violence has a human face, forgive a man his violence" in a society which is democratic in the practice of its scientific and artistic activities, allowing each person the right to his knowledge and imagination to always look ahead using his foresight to achieve his personal needs. Using Abraham Maslow's term, the person is self-actualising.
Chapter 6: Bronowski’s Compassion for Humans Reaches its Ascendancy.

“If we value variety in human beings, we cannot be squeamish in admitting that as a consequence, man will go on behaving quite strangely.” Jacob Bronowski, Technology and Culture in Evolution 1972.

“What is wrong is not the great discoveries of science – information is always better than ignorance - no matter what information or what ignorance. What is wrong is the belief behind the information, the belief that information will change the world. It won’t. Information without human understanding is like an answer without a question – meaningless. And human understanding is only possible through the arts. It is the work of art that creates the human perspective in which information turns to truths.” Archibald McLeish, American poet at the opening of the Lincoln Centre Festival (1920–30 period) in Abraham Maslow, 1971.

6.1 Lower than the Angels. (Anatomy and Intellect)

In her 1975 review, The Man Behind the Ascent of Man Jacob Bronowski, the American science journalist Cristine Russell, writing in the journal Bioscience lists the titles of the thirteen segments which I will head for ease of reference as the discussion proceeds. The comments after the heading of each segment are from Cristine Russell, eg (Anatomy and Intellect) Segments from 1 to 13 in order of presentation in both TV and book form are:

1. Lower than the Angels (Anatomy and Intellect)
2. The Harvest of the Seasons (Agriculture)
3. The Grain in the Stone (Architecture)
4. The Hidden Structure (Chemistry)
5. The Music of the Spheres (Mathematics)
6. The Starry Messenger (Astronomy)
7. The Majestic Clockwork (Physics)
8. The Drive for Power (Industrial Revolution)
9. The Ladder of Creation (Theory of Evolution)
10. World within World (Atomic Energy)
11. Knowledge or Certainty (Science and Humanism)
12. Generation upon Generation (Genetics)
13. The Long Childhood (The Future)
It would be a superficial response to regard these thirteen titles as dealing with material that has been considered in the previous five chapters, because the contents together build a statement. Russell comments that “Bronowski spent 66 years rehearsing for The Ascent of Man (Russell, 1975, p9) while Jonas Salk said “He was …….. an interpreter of life communicating with artistry the hopes of man as well as the realities with which he must cope.” (Russell, 1975, p12). On the first page of Russell’s article, she has placed a photograph of Bronowski genially and tenderly pointing out an area of the human skull.

![Figure 6.1 Bronowski with a Human Skull.](image)

For me, the photograph says “human specificity” and The Ascent of Man is an elaborate account of how mental or brain behaviour gives humans imagination, hindsight and foresight as discussed in The Identity of Man and elaborated in specific studies such as the works of William Blake and the poets in The Poet’s Defence, never forgetting Clarissa’s Compassion as in The Face of Violence.

It is my intention to examine what I call Bronowski’s philosophy of human specificity, by selecting aspects of each of the thirteen segments. The word ascent in the title of the series means humans continually move beyond themselves. Bronowski often emphasises that we are not taped digital machines. It is an idea to him because, there is much variety going right back to the early humans chipping stone axes from rocks and coming forward to the atomic pile, the atomic
bomb, supersonic aircraft, and modern medicine as examples from his own time. All are uniquely human inventions, and artefacts and the developments are not achieved in an orderly pattern.

But lest these examples read like a detached orientation, Bronowski in giving “A Personal View” in the thirteen studies said “Its subject is a contemporary version of what used to be called Natural Philosophy. In my view we are in a better frame of mind today to conceive a natural philosophy than at anytime in the last three hundred years ... because the recent findings of human biology have given a new direction to scientific thought, a shift from the general to the individual, for the first time since the Renaissance opened the door into the natural world.” (Bronowski, 1973, p15)

![Figure 6.2 Child Beginning to Walk (Bronowski, 1974)](image-url)

The door is open to the child on its feet, arms outstretched reaching out to the world and not knowing what he/she will find. (Bronowski, 1973, p32)

I shall not discuss the evolution of the modern day human from the hominid and Bronowski’s reference to the Australopithecus, since these developments have been referred to in earlier discussions of the thesis. Nor will I review 1.1 Lower than the Angels since the nomad human is a beginning in humans living and roaming across parts of the earth. Rather “The largest single step in the ascent of man is the change from nomad to village agriculture.” (Bronowski, 1973, p64)
6.2  The Harvest of the Seasons.  (Agriculture)

"Settled agriculture creates a technology from which all physics, all science takes off ...... the sickle, plough, wheel, cart, pulley, with the development of animals such as goat, sheep, ox, ass, horse, dog with the development of land tenure, and social relations" (Bronowski, 1973, pp74ff). The fact is that agriculture and the settled way of life were established steps now in the ascent of man, and land set a new level for a form of human harmony which was to bear fruit (a nice pun by Bronowski) into the far future; the organization of the city." (Bronowski, 1973, p89)


When he comes to segment 3, Bronowski takes a very broad approach to the word Architecture which is ‘The Grain in the Stone.’ The broad view is an example of how Bronowski communicates Natural Philosophy, incidentally not philosophy such as that practised by Hegel divorced from the real world. Bronowski asserts that the earth has been shaped by inner and outer forces. “The earth has existed for more than four thousand million years; it has been shaped and changed by two kinds of action. The hidden forces within the earth have buckled the strata and lifted and shifted the land bases. And the surface, the erosion of snow and rain and storm, of stream and ocean, of sun and wind have carved out a natural architecture. Man has also become an architect of his environment, but he does not command forces as powerful as nature. His approach has been selective and probing, in which action depends on understanding,” (Bronowski, 1973, p91). Bronowski’s words about the human approach is reminiscent of his topological studies the titles of which so intrigued his wife Rita, as I reviewed in Chapter 1. In Chapter 7 The Visionary Eye Bronowski has a lecture “Architecture as a Science and Architecture as an Art,” which provides wide discussion of his views on architecture.

Bronowski goes on to relate the grains in the stones and he looks in a Canyon in Arizona, with “The notion of discovering an underlying order in matter in man’s basic concept for exploring nature.” (Bronowski, 1973, p95). This basic concept of order in matter recurs in future segments as part of the ascent: Mendeleev’s ideas of atomic weight, Bohr’s quantization of the atom being examples. And
Bronowski relates the grain in the stone to the order in matter and humans saying “We human beings are joined in kinship groups in clans, the clans in tribes, the tribes in nations.” (Bronowski, 1973, p95). The order in the structure of stone and the order in human societies is underlaid by the process of “fundamental particles make nuclei, the nuclei join in atoms, the atoms join in molecules, the molecules join in bases, bases direct the assembly of amino acids, the amino acids join in proteins.” (Bronowski, 1973, p96). And so Bronowski links the physical and the social, each in orderly succession, onto human specificity at the Salk. The style of word usage has the sense of Bronowski’s early Cambridge studies in geometry and topology. The pattern of the linkage seems to me to confirm Cristine Russell’s statement that the ascent in The Ascent of Man took Bronowski the 66 years of his life.

To round out his account of the grain in the stone, the orderliness in stone, relating to humans, Bronowski says “There is one gift above all others that makes man unique among the animals, and it is the gift displayed everywhere here: his immense pleasure in exercising and pushing forward his own skill” (Bronowski, 1973, p113).

Of all the photographs of rocks, canyons, temples, mosques, cathedrals that Bronowski uses to illustrate this segment, The Grain in the Stone I have chosen Michelangelo’s carved head of Brutus from quarried marble. Here is the grain in the stone and the pleasure of Michelangelo’s skill:

![Michelangelo's Carved Head of Brutus](image)

*Figure 6.3 Michelangelo’s Carved Head of Brutus.*
With the caption “To break the marble spell is all the hand that serves the brain can do.” The carving is in the Bargello Museum, Florence. (Bronowski, 1973, p114).

6.4 The Hidden Structure. (Chemistry).

Bronowski gives a fresh interpretation of the word “ascent” when he moves to the next segment, 4. The Hidden Structure. In this segment “ascent” can mean a step “forward” rather than a step “upward.” Elaborating, Bronowski says, “man stood poised ....... to make a hard metal with a cutting edge ....... the grand transformation that helped to make our civilization go deeper; it is the use of fire to disclose a wholly new class of materials, the metals. This is one of the grand technical steps in the ascent of man, which ranks with the master invention of stone tools; for it was made by discovering in fire a subtle tool for taking matter apart. Physics is the knife that cuts into the grain of nature; fire, the flaming sword, is the knife that cuts below the visible structure, into the stone,” (Bronowski, 1973, pp124-5). Bronowski now reveals the Hidden Structure in metals – copper, bronze, iron, steel, gold. “From the discovery that fire will smelt metals comes, in time, the more subtle discovery that fire will fuse them together to make an alloy with new properties.” (Bronowski, 1973, p128). From the use of fire to create new properties as metals – opening up the Hidden Structure – Bronowski, still dealing with new properties and hidden structures takes a turn, introducing the names of Paracelsus, Joseph Priestley, Antoine Lavoisier, and up to John Dalton, he whom I referred to earlier in this thesis.

I will make only limited considerations of these four men’s discoveries because it is the nature of the men, their personalities that pushes the ascent forward; as much as their work. This is a theme that I have presented on previous occasions be it William Blake or Philip Sidney in poetry, the blunt Ernest Rutherford and the ‘open to enquiry’ Niels Bohr or the highly individualistic Albert Einstein to mention some personalities.

As Bronowski says, “Paracelsus (1493 – 1541) was a character. We catch in him, perhaps for the first time, the transparent sense that a scientific discovery flows from a personality, and that discovery comes alive as we watch it being made by the person. Paracelsus was a practical man who understood that the treatment of a
patient depends on a diagnosis (he was a brilliant diagnostician) and a direct analysis by the doctor himself. He broke with the tradition by which a physician was a learned academic.” (Bronowski, 1973, p141)

![Figure 6.4 Portrait of Paracelsus.](image)

Pursuing the conflict between originality and tradition, Bronowski comes to Joseph Priestley, two hundred and fifty years after Paracelsus. Priestley discovered a new element, oxygen which at last explained the nature of fire, as a process not as a Greek element. Bronowski relates Priestley and his work to the significance of persons in the ascent process. Bronowski explains “I do not think Priestley was very lovable, any more than Paracelsus. I suspect he was a rather difficult, cold, cantankerous, precise, prim, puritanical man.” (Bronowski, 1973, p144).

![Figure 6.5 Joseph Priestley.](image)
I have not discussed Priestley’s work because as I have said before, I want to explain how the ascent goes on by men and women who enquire into natural philosophy. Bronowski summarizes this point when he says, “...... the Ascent of Man is not made by lovable people. It is made by people who have qualities and immense integrity, and at least a little genius, Priestley had both.” (Bronowski, 1973, pp 144, 148). There is another man, a Frenchman who perished in the French Revolution,” the clear revolutionary mind of Antoine Lavoisier who working with Priestley was able to develop an “instant clue to the idea that chemical decompositions can be quantified.” (Bronowski, 1973, p148). In the process of ascent Priestley and Lavoisier led on to John Dalton who “took the notion of chemical elements” and expressed them in “atomic terms”. John Dalton, who in 1805, published his concepts of the form of combination of symbols for elements, the knowledge of atoms in different combinations to produce different substances.” (Bronowski, 1973, p151ff). Water is H₂O, “2 atoms of oxygen each combined with the necessary quantity of hydrogen ...... It is the exact arithmetic of the [Dalton] atoms which makes chemical theory the foundation of modern atomic theory” (Bronowski, 1973, p152). So the Hidden Structure segment spans all the work done on the metals from copper to bronze and gold, then Priestley, Lavoisier to Dalton heading to the modern atomic theory.” (Bronowski, 1973, p153).

I want to emphasize as Bronowski does “That the essence of science : ask an impertinent question and you are on the way to the pertinent answer.” (Bronowski, 1973, p153). So like Niels Bohr’s advice to his students to take any statement he makes and always regard it as a question. As the segment proceeds it becomes more and more the case that humans by their imagination, hindsight and foresight, driven by courage, by the desire to create, generate the power to climb the steps of The Ascent of Man.

6.5 The Music of the Spheres. (Mathematics)

Segment 5, The Music of the Spheres has had a special value for me, as I illustrated early in the thesis. My secondary school years and even in Mathematics I in 1947 at University of Sydney, geometry and the calculus were intellectually and emotionally dull topics. But I still remember segment 5 of the TV series when
Bronowski lands on the Greek island of Samos, only a mile off the coast of Asia Minor and he makes Pythagoras live. More than that, Segment 5 moves from the substance of the natural world — agriculture, nomad tribesmen, stone structure, making metals, discovery of the atomic basis of materials into the delicacy, and imagination comparable with poetry, into mathematics. Bronowski opens the segment with the statement “Mathematics is in many ways the most elaborated and sophisticated of the sciences — or so it seems to me, as a mathematician.....” (Bronowski, 1973, p155).

Mathematics fits well with The Ascent of Man since Bronowski characterizes it as “a ladder for mystical as well as rational thought in the intellectual ascent of man ....... any account of mathematics should include the logical idea of proof, the empirical idea of exact laws of nature (of space particularly), the emergence of the concept of operations and the movement in mathematics from a static to dynamic description of nature.” (Bronowski, 1973, p155).

Bronowski’s own interest in topology is included here with the reference to space, and the paradoxes and subtleties of Epimenides, Godel, Hilbert and Russell discussed in The Origins of Knowledge and Imagination.

Pythagoras, was born on Samos about “580 BC, the first genius and founder of mathematics.” (Bronowski, 1973, p1598). In essence, Pythagoras found a basic relation between musical harmony and mathematics ....... (he) was a pioneer in linking geometry with numbers.” (Bronowski, 1973, p158 - 161) and as I amply considered early in the thesis, he proved a “general theorem ....... for every triangle that contains a right angle (was)

\[ c^2 = a^2 + b^2 \]

*Figure 6.6 Pythagoras’ Theorem*
taken up”, and made famous (by) Euclid in Alexandria at 300 BC …… being a step in knowledge or what I have called the Ascent of Man.” (Bronowski, 1973, p165). The other harmony, to use the word from the mathematics of Pythagoras and Euclid was the science of astronomy developed by Ptolemy who was working in Alexandria about “AD 150 …… The model of the heavens that Ptolemy constructed is wonderfully complex, but it begins from a simple analogy …… The moon revolves around the earth, obviously; and it seemed just as obvious to Ptolemy that the sun and the planets do the same …… Ptolemy [a Greek] made the planets run on circles, or on circles running in their turn on other circles …….. It lasted for fourteen hundred years.” (Bronowski, 1973, pp164-5). I have included Ptolemy’s work here because of the harmony of the circles and epicircles and his work is a step forward in the ascent because as Bronowski says “astronomy was developed so early and so elaborately, and in effect became the archetype for the physical sciences.” (Bronowski, 1973, p164-5). Now, Bronowski goes on to consider “The coming of Islam six hundred years after Christ” (Bronowski, 1973, p165) and it opens another era in the ascent – the scholarly love of writing numbers, the decimal system which the Arabs brought from India, geometric patterns which Bronowski illustrates from the walls of the Moorish fortress, the Alhambra. But I do not want to enquire into their development although the patterns have their “music” so to speak. What is most significant in the ascent of man is the emergence after Pythagoras, Ptolemy and the Arabs and Moors of the movement of the intellect to the North of Europe. This happens after Segment 6 which is called – The Starry Messenger, then in segment 7 two superb minds of the late seventeenth century – Isaac Newton and Gottfried Wilhelm Leibniz emerge. They who brought in the idea of a tangent, the idea of acceleration, the idea of slope, the idea of infinitesimal, of differential and, mathematics becomes a dynamic mode of thought, and that is a major mental step in the ascent of man. The laws of nature had always been made of numbers since Pythagoras said it was the language of nature. But now the language of nature had to include numbers which described time. The laws of nature became the laws of motion because the laws of nature and nature herself became not a series of static frames but a moving power.” (Bronowski, 1973, pp184, 187).
The language of the step forward to Newton and Leibniz became modern. The words are familiar to us in the twenty-first century and indeed represent an ascent from the stone chipper and pebble collector of so long ago. It is the amazing development of science, ie. nature by imagination, foresight and hindsight that moved me to later discuss Bronowski’s lectures The Visionary Eye in chapter 7.

6.6 The Starry Messenger. (Astronomy)

The title The Starry Messenger of segment 6 is the title of a book published in Venice in 1609–1610 by Galileo. To go back to the beginning of segment 6, Bronowski continues with Astronomy which he asserts exists even in rudimentary forms in all cultures. He says, “One reason for this is clear. Astronomy is the knowledge that guides us through the cycle of the seasons – for example, by the apparent movement of the sun.” (Bronowski, 1973, p189)

I am always intrigued by the position of the setting sun as I watch it from the terrace of my house in Gooseberry Hill, Perth. In winter, the sun moves to a halfway position on the horizon and sets “quietly” compared with the blazing sunset which occurs at twice that position along on the horizon in summer. As Bronowski elaborates “.....there can be fixed a time when man should plant, should harvest, move their herds and so on. Therefore, all settled cultures have a calendar to guide their plans .......” (Bronowski, 1973, p189).

And then, astronomy does not stop at the calendar, and Bronowski moves on to an extensive discussion, “The movements of the stars in the night sky can also serve to guide the traveller, and particularly the traveller at sea who has no other landmarks.” (Bronowski, 1973, p190).

The movement of the stars in the night sky, and whether the sea traveller is in the Northern or Southern Hemisphere allows Bronowski to provide an extensive account of celestial navigation: paying special attention to sailors landing on Easter Island, located over a thousand miles from the nearest habitation on Pitcairn Island. And those who landed on Easter Island would not get off – why not? They had no Pole Star, no clockwork device built around the Ptolemaic circular movement of the planets, with seven dials on the clock face representing the seven planets and their movements. The complicated Ptolemaic devise allows
Bronowski in his remarkably orderly fashion to give an account of another step forward, “the heavens must have one machinery, not seven.” (Bronowski, 1973, p196). But that machinery was not found until Copernicus put the sun at the centre of the heavens in 1543.

In time another large step forward came, with the birth of Galileo in 1564. I sense and enjoy Bronowski’s pleasure at the forward movement in knowledge of nature, his natural philosophical interest in Copernicus and Galileo.

“Nicolaus Copernicus was a distinguished churchman and a humanist intellectual from Poland, born in 1473. For at least twenty years of life, roughly, he devoted himself to the modern proposition that nature must be simple.” (Bronowski, 1973, p196). And simply, “Copernicus asked, why not look at them [the planets] from another place? [than earth]. There were good Renaissance reasons, emotional rather than intellectual reasons, that made him chose the golden sun as the other place.” (Bronowski, 1973 p197).

Bronowski points out that the title of Copernicus’ book The Revolution of the Heavenly Orbs can be interpreted as a play on the word “Revolution,” not intended by Copernicus, with his conception of the sun at the centre of the planets came the Renaissance “as a single rush in religion, art, literature, music and mathematical science, a head on collision in the medieval system as a whole.” (Bronowski, 1973, p198).
Bronowski describes Galileo as “a short, square, active man with red hair and rather more children than a bachelor should have. Galileo is the creator of the modern scientific method.” (Bronowski, 1973, p 200). He did not just turn the Flanders spy glass into a navigation instrument to be used by ships at sea or to see ships coming into the Venetian port, so that by 1609-1610, he published The Starry Messenger which gave his account of how he was able to see “myriad of stars [and] to call the attention of all astronomers and philosophers ...... that I have discovered four planets [satellites of Jupiter] neither known nor observed by any one of the astronomers before my time .... [and] how [Galileo] turned the telescope on the moon herself” (Bronowski, 1973, p204). Bronowski revealed the philosophical significance of Galileo’s scientific method; “..... the Ptolemaic heaven simply would not work. Copernicus’ powerful guess had been right and now stood open and revealed.” (Bronowski, 1973, p204).

Bronowski relates the shock of Galileo’s work confirming Copernicus when he brings the huge ascent made by Galileo into modern times, the late nineteenth and twentieth centuries. He says “it was like many more recent scientific results, that did not at all please the prejudice of the establishment of his day” Doubtless the move from Newtonian absolutism to Einsteinian relativity, the developments in the quantization of the atom and some academics who objected to the BBC proposal to make the 13 segments of The Ascent of Man. Bronowski has convinced me that nothing is still or static and this is expressed in the quotation from Bronowski at the start of this chapter.

Bronowski provides a powerful account of the Roman Catholic Church fighting the Reformation in Europe. Galileo, a man innocent in politics had incurred the profound disapproval of the Church. Bronowski gives a graphic picture of the Church Codex of 1616 which forbade the Copernican system. He described the power of church prohibition as “the ethics of the police state,” seemingly akin to the Nazi and Stalin states of his own time in the twentieth century, three centuries later on. “They (the church authorities) believed that faith should dominate, and Galileo believed that truth should persuade ..... [and] his trial [took place] in 1633. (Bronowski, 1973 p205)
Bronowski’s BBC radio play *The Face of Violence* comes to mind with the Bosscamp incident when the guards killed the child and Clarissa’s compassion rising above the violence of her time. It is like the Inquisition which denounced Galileo though he was innocent of political power, or the evil of the Nazi state which forced the liberal thinkers in science and the arts to flee Germany.

But Galileo the man won out, and this is how the ascents take place, by the courage of the individual to go forward over the fears of their own selves or the power of the state. This issue has been referred to in earlier chapters, eg Maslow’s study of the fear of the creative individual who must not retreat into isolation (Maslow, 1971).

Despite the power of the Inquisition representing Church tradition forcing Galileo to retreat from promoting the Copernican world system, Bronowski said that “Galileo made up his mind to do one thing. He was going to write the book that the trial had interrupted, the book on the new sciences, by which he meant physics, not in the stars but concerning matter here on earth. He finished it in 1636, three years after the trial, an old man of seventy two.” (Bronowski, 1973, p218). It was printed in the Netherlands by some Protestants, 2 years later. By now Galileo was totally blind.

Bronowski now foreshadows the next ascent: “The effect of the trial and of the imprisonment [his house arrest by church power] put a total stop to the scientific

6.7 The Majestic Clockwork. (Physics)

And so, segment 7 The Majestic Clockwork is presented. Having come from the death of Galileo in sad circumstances in the last years of Galileo’s life, Bronowski creates a sense of theatre and drama or perhaps excitement as he announces the entrance of Isaac Newton. My sense of theatre and excitement is really a human reaction to George Derfer’s observation, cited in chapter 4, that Bronowski is distinctive if not unique in linking natural science and the arts as normal features of human specificity.

Introducing the person of Isaac Newton, Bronowski relates Newton’s unfortunate experiences in his boyhood years. He was born prematurely, three months after the death of his father, the owner of Woolsthorpe Manor in Lincolnshire. His mother remarried early in Newton’s life and he was put in care of a grandmother at Woolsthorpe, and came under the influence of his uncle, who recognised his talents. Newton went to the grammar school in Grantham and after farming at Woolsthorpe for two years was sent to Trinity College, Cambridge.

“He remained there for nearly forty years ....... he often dined in college ..... stockings untied, hair barely combed.” (Webster) Bronowski observes that (Newton) was not exactly a homeless boy, and yet from that time because he knew no intimacy as a child he shows none of the intimacy later that people give to each other. All his life he makes the impression of an unloved man ....Newton’s achievements were solitary, and he always feared others would steal from him .....” (Bronowski, 1973, pp222ff).

Bronowski’s account of the personal history of Newton is also valuable to the reader or the viewer because it helps to reduce the public mystic about scientists as white-coated bespectacled men.

Newton graduated from Cambridge and in 1665-66, the Plague years, he stayed at home with his mother, she widowed at this time, at the original house at
Woolsthorpe where “He struck his vein of gold: mathematics” (Bronowski, 1973, p222)

Figure 6.10 Woolsthorpe Manor

Bronowski goes on to discuss and develop Newton’s contribution: the “fluxions, what we now call the calculus ...... [he] also conceived the idea of universal gravitation ...... Newton published his first work in optics ....” (Bronowski, 1973, p223)

Since Newton’s works have been referred to and discussed in earlier chapters, eg, his imagery of the apple falling to the ground, and the apple being thrown out to the horizon and circling the earth I only want to make reference to this work now, although Bronowski develops such explanation. What I want to do is give a further portrait of Newton, the man. The arguments among his contemporaries such as Robert Hooke with Newton’s studies in the colour of the spectrum in white light made him write to Leibniz: “I was so persecuted with discussions arising from the publications of my theory of light that I blamed my own imprudence for parting with so substantial a blessing as my quiet to run after a shadow” and Bronowski notes “From that time on he [Newton] refused to have anything to do with debate at all .......” (Bronowski, 1973, p226).

Such an unusual man was Newton, prone to keep himself to himself that although he conceived the idea of universal gravitation in 1666 it was not until the years 1684 to 1687 before he wrote out the proof, and then at the request of an astronomer Edmund Halley and Samuel Pepys, president of the Royal Society accepted it. Scientists, natural philosophers, mystics call them what you will, Bronowski time and again shows them to be colourful people just as imaginative
in their way as the poets, painters and musicians. *The Ascent of Man* is by no means a steady, orderly process – it can be as wobbly as the young child on its feet, hands reaching out.

Bronowski wants his readers and viewers to know this. Despite Newton’s own assertions about his work style: “I do not make hypotheses” Bronowski points out that what Newton meant was “I do not deal in metaphysical speculations. I lay down a law and derive the phenomena from it.” (Bronowski, 1973, p234)

Yet Newton is not the plain, orderly thinker – the white coated, bespectacled man. Bronowski says to his viewers or readers; “....I must make you see that he was not. He was really a most extraordinary, wild character. He practised alchemy. In secret he wrote immense tomes about the *Book of Revelations*. He was convinced that the law of inverse squares was really already to be found in Pythagoras and for such a man, who in private was full of these wild metaphysical and mystical speculations, to hold this public face and say ‘I make no hypotheses’ – that is an extraordinary expression of his secret character. William Wordsworth in *The Prelude* has a vivid phrase, which he sees and says it exactly.” (Bronowski, 1973,p234)
Bronowski continues to discuss Newton, his religion, his public career and knighthood by Queen Anne in 1705. Newton as portrayed by Bronowski is an excellent study of ‘human specificity,’ Bronowski’s own special interest at the Salk Institute. It could well be said that Newton as a boy lacked a sense of intimacy and acceptance in parental relationships and so he suffered Maslow’s deficiency needs of deprivation of love and self esteem in his relationship with people. In Newton’s case because the deprivation was so early in his childhood, it can be regarded as a biological deficiency. As he grew up and used his intellect his statement “I make no hypotheses” reflects his sense of isolation from people, and his private life as a wild character, as Bronowski describes him. Thus Newton is an example of human specificity in biological – cultural features. Webster reinforces Bronowski’s “lack of intimacy” my Maslowian interpretation as suffering deficiency needs by reporting “In 1692 Newton lost his reason, probably suffered a period of severe depression” Bronowski moves on from Newton to discuss a decline in science as Tories were focussed on money matters and satirising of Newton was popular in the theatres.

Time and space were absolute in Newton’s perceptions, perhaps absolutism is a defensive safeguard, a defence mechanism against letting people – other scientists or the politicians or public manipulate him. In any event Bronowski goes on to consider another outlook on time – Einsteinian relativity.

References have been made to Einstein in other parts of the thesis so I will not pursue Bronowski’s detailed discussion of Einstein’s work, other than record an essential thought: “What would the world look like if I rode on a beam of light” (p246) and contrast it to Newton. Bronowski saw this as a key idea in Einstein’s thought.
Bronowski says “For Newton, time and space formed an absolute framework, within which the material events of the world run their course in imperturbable order. By contrast, Einstein’s is a man’s or woman’s eye view, in which what you see and what I see is relative to each of us, that is our place and speed. And this relativity cannot be removed. We cannot know what the world looks like in itself, we can only compare what it looks like to each of us, by the practical procedure of exchanging messages.” (Bronowski, 1973, p249).

Here Bronowski contrasts well, the deficiency needs in human contact of Newton with Einstein’s openness of himself to people, and Bronowski thus shows how the ascent of man’s knowledge is not orderly, like a flight of steps – as I have said before, it is variable like a child on its feet reaching outwards.

Bronowski concludes segment 7 by saying “It is almost impertinent to talk of the ascent of man in the presence of two men, Newton and Einstein, who strode like gods. Of the two, Newton is the Old Testament God, it is Einstein who is the New Testament figure. He was full of humanity, pity, a sense of enormous sympathy ……” (Bronowski, 1973, p256). C.P. Snow confirms Bronowski’s characterization of Einstein. Snow recounts that when the first bomb was dropped on Hiroshima, he (Einstein) said simply “Oh weh” (Oh, horrible!)” (Snow, 1969, p101).
Bronowski proceeds to the next segment 8 still in a revolutionary mode – from Galileo, Newton and Einstein to *The Drive for Power*; segment. He introduces the significance of the title with the opening paragraph: "Revolutions are not made by fate but by man. Sometimes they are solitary men of genius [segment 7]. But the great revolutions in the eighteenth century were made by many lesser men banded together. What drove them was the conviction that everyman is master of his own salvation." (Bronowski, 1973, p259). The men banded together in the eighteenth century to produce the Industrial Revolution which began in 1760. But that era had many revolutions such as the French and American Revolutions, both social revolutions. Bronowski points out that "The Industrial Revolution was simply the English way of making social changes. I think of it as the English Revolution." (Bronowski, 1973, p259). The term "Industrial Revolution" brings to mind *William Blake and the Age of Revolution* which I considered at length in chapter 3.

With his optimism, Bronowski points to social and personal improvements to the lives of the working class, what he describes as "a transformation in the lives of the poor ...... coal in an iron range, glass in the windows, a choice of food ...... the iron bedstead saved more women from childbed fever." (Bronowski, 1976, p279).

Bronowski's generosity of spirit, his optimism despite degradation and demeaning of people is the reason why I so enjoy his work. Clarissa's compassion, human specificity such as imagination, speech, foresight and hindsight in the arts and the sciences are examples.
This picture contrasting with the picture of the cottage weaver and labourer is a graphic indication of the Industrial Revolution as a step in the ascent of man.

The Drive for Power in society means a new word comes into significance; “Power is a new preoccupation, with different meanings, in science and society. The Industrial Revolution, the English revolution turned out to be the great generator of power. Sources of energy were sought in nature: wind, sun, water, steam, coal. And a question suddenly became concrete: Why are they all one? What relation exists between them?” (Bronowski, 1973, p280). That is an ascent question because transforming nature in order to obtain power, changing one form of power into another and the awareness that heat is a form of energy which could
be converted into other forms of energy, lead in 1824, to “Sadi Carnot, a French engineer, looking at the principles of steam engines. “He founded in essence the science of thermodynamics ..... Energy had become a central conception in science ..... and equally in the arts ..... poets and painters were suddenly captured by the idea that nature is a fountain, whose different forms are all expressions of the same central force, namely energy ..... William Blake, [said] very simply: ‘Energy is Eternal Delight’." (Bronowski, 1973, p285).

Not only did the ideas of power, energy, thermodynamics infuse the serious issues of the bridges, canals, coal pits but Bronowski enjoys pointing out how all sorts of eccentric ideas delighted the Saturday evenings of the working families. Most of all, James Watt and Richard Trevithick turned the steam engines in to a mobile power source, and so developed the invention that rounded out the Industrial Revolution as the canals had begun it: the railways. “It was a life-giving act, which opened the blood-stream of communication for the world and made England the heart of it.” (Bronowski, 1973, pp285-6).

The richness of Bronowski's language like "blood stream of communication" links the sciences, technology and the arts: "Energy is Eternal Delight" not only giving energy to the ascent of the Industrial Revolution but also giving confirmation to Bronowski's belief in science and poetry ‘being of the one’!

Even today some sixty years on from my youth, I can recall the thrill of delight at seeing the NSW Government Railways 38 Class steam engine in its vivid green colours drawing the Melbourne express from Sydney down into Albury, NSW. As Bronowski moves towards the conclusion of The Drive for Power he says 'We still live in the middle of the Industrial Revolution and find it hard to see its implications, but the future will say of it that in the ascent of man it is a step, a stride as powerful as the Renaissance. The Renaissance established the dignity of man. The Industrial Revolution established the unity of nature.” (Bronowski, 1973, p286).

For me, the dignity of man and the unity of nature come together in William Blake’s statement: “Energy is eternal delight.” At the beginning of this chapter I selected a phrase from Bronowski’s study “Technology and Culture in Evolution” in which key words in the ascent of man are “variety” and “we will go on evolving quite strangely.” These are terms appropriate to introduce segment 9.
6.9  *The Ladder of Creation* (Theory of Evolution)

Early in this segment, Bronowski indicates the mystery of life when he says "The manifestations of life, its expressions, its forms, are so diverse that they must contain a large element of the accidental. And yet the nature of life is so uniform that it must be constrained by many necessities." (Bronowski, 1973, p291).

Much of this segment is spent with Bronowski discussing the two principal persons who developed the theory of evolution – Charles Darwin and Alfred Russel Wallace, and later in the segment, reference is made to Louis Pasteur's work on the chemistry of life. Discussing the personal histories of these men Bronowski does, for my purpose, express creation or evolution as one of his basic accounts of the ascent of the human species, or really all life. Bronowski's explanation centres on his phrase: "evolution of complexity by stratified stability." I have selected aspects of segment 9 that are relevant to his phrases.

Wallace, was a young man exploring life in the Amazon basin, and Bronowski notes "Sooner or later amid the pleasures and the labours of the forest the burning question began to flicker in Wallace's acute mind. How had all this variety come about, so elite in design and yet so changeable in detail? Like Darwin, Wallace was struck by the differences between neighbouring species, and like Darwin he began to wonder how far they had come to develop so differently." (Bronowski, 1973 pp300-331). "Alfred Wallace returned from the tropics as Darwin had done, convinced that related species diverge from a common stock, and nonplussed as to why they diverge. What Wallace did not know was that Darwin had hit on the explanation two years after he returned to England from his voyage on the *Beagle* ....... reading Thomas Malthus' assertion that population multiplies faster than food. If that is true of animals, then they must compete to survive: so that nature acts as a selection force, killing off the weak, and forming new species from the survivors who are fitted to this environment." (Bronowski, 1973, p305). Here is the basis of Bronowski's "evolution of complexity."
Wallace wrote a paper on the idea of "the survival of the fittest", and sent a copy to Darwin who was astonished to find the same ideas coming from Wallace. Imagine Darwin's dilemma: "I never saw a more striking coincidence; if Wallace had my MS sketch written in 1842, he could not have made a better abstract." Bronowski summarizes the position "... so Darwin wrote the *Origin of Species*" and published it at the end of 1859, and it was instantly a sensation and a best seller." (Bronowski, 1973, p308).

For Bronowski, 'evolution' is such a powerful word because for Bronowski "it is evolution which is the real creation of originality and novelty in the universe." (Bronowski, 1973, p309).
Bronowski introduced what I characterize as the second part of the segment with the question which Darwin and Wallace pondered “What could the simplest first unit be? Presumably they are chemical molecules that characterize life. So when we look back for the common origin of life today we look even more deeply, at the chemistry that we all share.” (Bronowski, 1973, p309).

Bronowski’s account of chemistry introduces chemist Louis Pasteur in France in 1860’s and biologists Stanley Miller and Leslie Orgel in America in 1950’s. Bronowski introduces the key concept when he says “The blood in my finger at this moment has come by some millions of steps from the very first primeval molecules that were able to reproduce themselves over three thousand million years ago. This is evolution in its contemporary conception.” (Bronowski, 1973, p316)

Pasteur's significance centres round disproving that "Fables about creatures that came to life spontaneously, are very ancient and are still believed although Louis Pasteur disproved them beautifully in the 1860's, through his work on fermentation of milk and then fermentation of wine showing how there are molecules that have a characteristic shape ....... For the first time Pasteur had linked all the forms of life with one kind of chemical structure. From that powerful thought it follows that we must be able to link evolution with chemistry." (Bronowski, 1973, pp309, 311, 313). Darwin and Wallace were not able to think in this manner when they puzzled over the origins of the variety of species.

Bronowski emphasises the post-Darwinian period when he says, "It is clear that we have to look for the evolutionary progress of life in a build up of chemical molecules, and Miller and Orgel worked on how molecules developed so long ago. In Bronowski's discussion of the evolution of molecules comes the phrase of his "evolution by complexity and stratified stability" which will recur further on and especially in the next segment.

Bronowski rounds off The Ladder of Creation segment 9 when he says "Biology has been fortunate in discovering within the span of one hundred years two great and seminal ideas. One was Darwin's and Wallace's theory of evolution by natural selection. The other was the discovery, by our own contemporaries, of how to
express the cycles of life in a chemical form that links them with nature as a whole" (Bronowski, 1973, p317).

6.10 World Within World. (Atomic Energy)

Segment 10, World Within World follows on naturally the exploration of the "cycles of life in a chemical form" and the reference to "chemical molecules" in Pasteur's studies in The Ladder of Creation. What is the world within the world of chemical molecules? Bronowski's exploration opens out the new physics of the late nineteenth and early twentieth centuries. World Within World is an imaginative step forward in the ascent, well worthy to set in line with such as Galileo, Newton, Darwin and Wallace. I find myself again drawn into the ascents and reminded of what Rita, Bronowski's wife, said of his Workers Educational Association lectures which Bronowski gave as a young graduate. The audiences enthralled by and respectful of Bronowski as an educator. To explain the world within the world in The Ascent of Man, Bronowski introduces the reader or the viewer to crystals - There are seven basic shapes of crystals in nature and a multitude of colours." (Bronowski, 1973, p321).

![Figure 6.17 Naturally Occurring Cubic Crystal of Common Salt](image)

Bronowski continues: "And it is true in modern terms that the crystals in nature express something about the status that compose them: they help to put the atoms into families. This is the world of physics in our own century, and crystals are the first opening into that world." (Bronowski, 1973, p321).

Bronowski considers the elements that compose the various crystals and he asks "What makes the family likenesses among the elements" [that comprises the various crystals]...... and this question allows Bronowski to introduce the first of the scientists in this new world: "a young Russian called Dimitri Ivanovich Mendeleev" ..... "What distinguished Mendeleev was not only genius, but a
passion for the elements .... The elements, of course, were distinguished each by only one basic property, that which John Dalton had proposed originally in 1805, each element had a characteristic weight. How do the properties that make them alike or different flow from that single given contrast or parameter? This was the underlying problem and Mendeleev worked at this. He wrote the elements out on cards [and] wrote on his cards the atoms with their atomic weight, and dealt them out in vertical columns in the order of their atomic weights." (Bronowski, 1973, p323).

I have given this introduction to the world within the world and some account of Mendeleev because it can be understood how it relates back to the chemical molecules in the theory of evolution in *The Ladder of Creation* and even more significantly it leads forward to a fundamental conception of evolution and growth of cells which Bronowski himself developed - "Evolution of Complexity by Stratified Stability" (Bronowski, 1973, p323).
I will not reproduce the card sequences and only include Bronowski's commentary on the sequence of cards: "...... there is something in the sequence of atomic weights that is not accidental but systematic." (Bronowski, 1973, p324). This is another forward looking clue to the world within the world in the ascending process.

And what seemed to be a problem in Mendeleev's plan of cards became a new awareness. Gaps occurred: out of what is now known as ninety two elements - from hydrogen to uranium, only 63 were known. Mendeleev's inspiration in ordering the elements showed the gaps as missing elements and by the process of induction he interpreted the kind of elements that were missing. This was Mendeleev's process of induction by understanding the nature of the elements and "made Mendeleev famous everywhere" (Bronowski, 1973, p326).

Mendeleev began his principal plan of classifying the elements in 1871 and the turning point in understanding the nature of atoms, beyond Mendeleev's conception of atomic weight, "comes in 1897, when JJ Thomson in Cambridge discovers the electron" and "The place in the table that the elements occupies is called its atomic number ..... the number of electrons there. The picture has shifted from atomic weight to atomic number, and that means essentially, atomic structure." (Bronowski, 1973, p330).

Thomson's discovery heralds "the great age. Physics becomes in those years the greatest collective work of science - no, more than that, the greatest collective work of art of the twentieth century." (Bronowski, 1973, p330).

Here Bronowski expresses the excitement of the ascent of man not in only science but also splendidly in capturing the "imagination of artists at once." (Bronowski, 1973, p350).

At this point Bronowski demonstrates his own ascendancy in relating science and poetry which George Derfer discussed earlier in the thesis. Surely it takes a man, Bronowski himself, as exceptional as scientist and artist to see the interrelation of science and art from Mendeleev and Thomson as scientists to Picasso, Seurat, Braque and other painters.

Bronowski explains himself: "I say 'work of art' because the notion that there is an underlying structure, a world within the world of the atom, captures the
imagination of artists at once. Art from the year 1900 on is different from the art before it, as can be seen in any original painter of the time ...... Modern art begins at the same time as modern physics because it begins in the same ideas ...... it looked for the base beneath the skin and for the deeper, solid structure that builds up from the inside the total form of an object or a body." (Bronowski, 1973, p332.)

Bronowski goes on to ......"The Cubist painters...[who] are obviously inspired by the families of crystals” and he mentions painters from “Picasso on including Franz Marc and Jean Metzinger.” (Bronowski, 1973, p332).

Bronowski mentions Niels Bohr, the quantum physicist, used money he was awarded for his Nobel Prize to collect pictures.

I have selected three painters whose work has always intrigued me because it departs so profoundly from pre-1900 art: as well as Picasso, there is Georges Seurat's dot paintings (from the dot, so to speak, of the electrons) and Georges Braque.
Bronowski doesn’t refer to his early work *The Poet’s Defence* [which I discussed in chapter 2] in *The Ascent of Man*. In that book he writes severely of the difference, of which he was aware, during his time at Cambridge University, between literary and science people there. The literary students were rather disdainful of science while the science students were unimaginative about literature. There is certainly no meaningful plan of ascent in knowledge when the early scientists and artists did not penetrate the 1920’s minds. This matter of knowledge, certainty, truth, rigidity and like issues form segment 11 *Knowledge and Certainty* to come next in *The Ascent of Man*.

Bronowski continues his natural philosophy by pointing out "There are two clear differences between a work of art and a scientific paper. One is that in the work of art the painter is visibly taking the world to pieces and putting it together on the same canvas. And the other is you can watch him thinking while he is doing it. (For example, Georges Seurat putting one coloured dot beside another of a different colour to get the total effect in *Young Woman with a Powder Puff* and *Lebec*). In both these respects the scientific paper is often deficient. It often is only an object; and it almost always hides the powers of thought in its impersonal language," Bronowski, 1973, p332). Too true! This is what I understand Bronowski to mean when he talks of the mystique of science to the general public.
Bronowski continues the ascent by enquiring into the world of Niels Bohr. I would refer the reader to my honours dissertation Humanistic Psychology and Quantum Thinking (Sarfatty, 1993) for an account of Bohr's personal history - his family of origin years, his own family, his professional development by his association from Copenhagen to England to work with JJ Thomson and then Ernest Rutherford. Bronowski describes Bohr as "one of the founding fathers of twentieth century physics ....... He had no ready made answers. He used to begin his lecture courses by saying to his student "Every sentence that I utter should be regarded by you not as an assertion but as a question." (Bronowski, 1973, p334).

Figure 6.22 Niels Bohr from P152 of Sarfatty (1993).

Rutherford at Cambridge proposed the atom to be like the solar system, a central proton like the sun with electrons orbiting around it like planets. But why didn't the energy of the orbiting electrons become used up and the electrons fall into the proton? Bohr put together the Rutherford atom and Max Planck's unit of quantum energy, the quantum and as the electrons move up or down in their orbits they emit quanta of energy. As Bronowski says "....... this was a wonderful, visible, thought process, nothing but an effort of synthesis." (Bronowski, 1973, p336). I acknowledge that such a simple account of the movement of electrons in the atom is too simple - Bronowski gives a more comprehensive explanation as my honours dissertation does. And continuing the ascent, Bronowski says "And just at this moment when everything seems to be going swimmingly, we suddenly begin to realize that Bohr's theory, like every theory sooner or later, is reaching the limits of what it can do ....... comes the crucial realization that we have not cracked the real problem of atomic structure at all, we have cracked the shell. But within the
shell, the atom is an egg with a yolk, the nucleus, and we have not begun to understand the nucleus. ....Bohr .... a man with a taste for contemplation and leisure .....[talking to Werner Heisenberg, a young man from Germany at Bohr's Copenhagen Institute] said 'when it comes to atoms, language can be used only in poetry. The poet too is not nearly so concerned with describing facts as with creating images.' (Bronowski, 1973, p339, 340).

Bronowski himself elaborates Bohr's account of atoms, poetry and images because it is just what Bronowski asserted about the creative behaviour of scientists and poets. I will not present here Bronowski's discussion because it is developed in chapter 5 of the thesis on The Origins of Knowledge and Imagination: But Bronowski's description of the ascent of man is rich enough to record. He says "The ascent of man is a richer and richer synthesis, but each step is an effort of analysis: of deeper analysis, world within world." (Bronowski, 1973, p340).

Bronowski applies this broad description of the ascent which occurred "...... about 1930. At that time the nucleus of the atom still seemed as invulnerable as the atom itself had once seemed..... It was James Chadwick who broke with that deeply rooted idea ["that the mass of the nucleus is not a constant multiple of the positive charge"] and proved in 1932 that the nucleus consists of two kinds of particles: not only electrical positive protons, but a non-electrical particle, the neutron. The neutron was a new kind of particle having no electrical charge. It could be fired into the nuclei of atoms without suffering electrical disturbance, and change them. The modern alchemist, the man who more than anyone took advantage of that new tool, was Enrico Fermi in Rome......when I saw him in New York ..... he struck me as the cleverest man I had ever set eyes on - well, perhaps the cleverest man with one exception. He was compact, small, powerful, penetrating, very sporty, and always with the direction in which he was going as clear in his mind as if he could see to the very bottom of things." (Bronowski, 1973, pp340, 341, 343).

I have positioned James Chadwick and then Enrico Fermi because they provide the idea of synthesis, one from another, and Bronowski's description of Fermi is another way to be compared, for example with E Paul Torrance account of characterizing the creative person. "Fermi, set about shooting neutrons at every
element in turn and the fable of transmutation came true in his hands. In 1939, Hans Bethe, working at Cornell University, for the first time explained in very precise terms the transformation of hydrogen to helium by the sun, by which a loss of mass streams out to us as this proud gift of energy ..... (finally ........ in 1957) in all the steps, there are going on processes which build up the atoms one by one into more and more complex structures. Matter itself evolves. The word come from Darwin and biology, but it is the word that changed physics in my lifetime.” (Bronowski, 1973, p344).

Bronowski goes on to give an account of the evolution of the elements from hydrogen to helium and into carbon and oxygen and he asks “If the elements are built up one by one, why does nature stop? Why do we find only ninety-two elements, of which the last is uranium?” (Bronowski, 1973, p344). Here Fermi made a new element beyond uranium, plutonium in his Graphite Reactor.
"When the elements become bigger and more complex they tend to fall apart into pieces." (Bronowski, 1973, p346). The irony is, that it was a plutonium bomb that killed forty thousand people at Nagasaki. The irony is not lost on Bronowski, when he says "It is one more time in the history of the world when a monument [the reactor of Fermi’s] commemorates a great man and many dead, together." (Bronowski, 1973, p347). It is this paradox which motivated Bronowski, when as Scientific Deputy to the British Chiefs of Staff, on a visit to Nagasaki he saw the devastation, and wrote Science and Human Values, which I discussed in chapter 4 of the thesis.

Bronowski concludes segment 10 with an account of the significance of "Ludwig Boltzmann in Austria who brilliantly seized on the idea of entropy to give a new interpretation of what happens in a machine, or a steam engine, or the universe. When energy is degraded, said Boltzmann, it is the atoms that assume a more disorderly state. And entropy is a measure of disorder." (Bronowski, 1973, p348). Boltzmann is not only important to Bronowski's study of the world within the world but also because Bronowski can relate Boltzmann to Bronowski's conception of 'stratified stability.'

Boltzmann asserted as part of the study of entropy and disorder that the atom was real, that it exists. This was a profound contribution by Boltzmann "that the atom exists", because as Bronowski notes "the great philosopher Ernst Mach in Vienna said No. The great chemist Wilhelm Ostwald said No." (Bronowski, 1973, p351).
This leads Bronowski to build evolution by stratified stability. When I say ‘leads’ I mean it gives Bronowski the opportunity to explain his concept of evolution of complexity by stratified stability. This is not to denigrate Boltzmann but to show a statistical contrast – in effect Nature is growth and decay. This will be illustrated by a poem of Dylan Thomas which Bronowski discusses in *The Visionary Eye* in chapter 7, to come. He says “Nature works by steps. The atoms form molecules, the molecules form bases, the bases direct the formation of amino acids, the amino acids form proteins and the proteins work in cells. The cells make up first of all the simple animals, and then sophisticated ones, climbing step by step .......
So long as there remains a potential of stability, which has not become actual, there is no other way for chance to go. Evolution is the climbing of the ladder from simple to complex by steps each of which is stable in itself ....... I call it ‘Stratified Stability’ .... And now we know that that is true not only of life but of matter...... A star builds hydrogen to helium; then at another stage in a different star helium is assembled to carbon, to oxygen, to heavy elements; and so step by step up the whole ladder to make the ninety two elements in nature.” (Bronowski, 1973, pp347 – 349). The work in contemporary physics to create the process of, for example, a star building hydrogen is a “new kind of physics: plasma-physics.” (Bronowski, 1973, pp347-349).

I gave a brief account of Boltzmann’s work with the emphasis on his essential contribution at that time – that the atom is real. Bronowski uses the idea to develop one of his fundamental beliefs, evolution of complexity by stratified stability. This chapter, segment 10, links back to the segment on Darwin and Wallace. Bronowski concludes segment 10 with the opinion, “Physics in the twentieth century is an immortal work. The human imagination working communally has produced no monuments to equal it ..... The pioneering heroes of our age. Mendeleev shuffling his cards, JJ Thompson who overturned the Greek belief that the atom is indivisible, Rutherford who turned it into a planetary system, and Niels Bohr who made the model work, Chadwick who discovered the neutron, Fermi who used it to open up and transform the nucleus, Max Planck who gave energy an atomic character like matter; and Ludwig Boltzmann to whom more than anyone else, we owe the fact that the atom – the world within a world – is as real to us now as our own world.” (Bronowski, 1973, p351). As
Bronowski says "... one man, at that critical turn of the century [19th Century] stood up for the reality of atoms on fundamental grounds of theory. He was Ludwig Boltzmann, at whose memorial I pay homage" (Bronowski, 1973, p351).

6.11 Knowledge or Certainty

Following the celebratory climax to segment 10, Bronowski begins segment 11, with the title Knowledge or Certainty. The nature of the segment could be described as metaphysical, and what springs to mind straight away is the fate of Galileo. He developed knowledge by looking out into the natural world of the planets and stars, developed a new cosmology by integrating his findings into the Copernicus world view and found himself in blunt conflict with the teachings of the Catholic Church who were certain their view from Aristotle and Aquinas was correct and must prevail. The knowledge of Galileo in his work The Starry Messenger was banned by the Inquisition, and he was confined to house arrest in his later years. The cost of certainty prevailing over knowledge meant natural science moved from Italy to Northern Europe and across to England.

There is a remarkable similarity to the banning of scientists and their findings in quantum physics, developed in the early twentieth century, which is so personal to Bronowski himself. In place of the Catholicism was Nazism and Fascism.

To set the metaphysical or epistemological nature of the topic, Bronowski begins with the assertion, "One aim of the physical sciences had been to give an exact picture of the material world. One achievement of physics in the twentieth century
is to prove that that aim is unattainable.” (Bronowski, 1973, p353). Bronowski contrasts the artist who explores and draws a subject - in this segment the face of a Polish man (p353) - and examples of artists like Picasso, Braque and Seurat provided earlier. “The exploration of a situation by the artist is never final.” (Bronowski, 1973, p353) and “what physics has now done is to show it is the only method to knowledge. There is no absolute knowledge. And those who claim it, whether they are scientists or dogmatists open the door to tragedy. All information is imperfect, [Newton described his calculations of the moon’s orbit as “pretty nearly” accurate]. We have to treat it with humility. That is the human condition; and that is what quantum physics says. I mean that literally.” (Bronowski, 1973, p353). Niels Bohr always said to his students when he lectured, to treat a sentence or a statement as a question.

This segment ends with photos of Hiroshima in ruins and humans destroyed at Auschwitz and Bronowski kneeling in a pool of ashes from the crematoria ...... due to the .... Germanic arrogance of the Nazis. Between the paradox of imperfect knowledge and Nazi arrogance as (Aryan righteousness) Bronowski traces the thinking and attitudes of the scientists from the late nineteenth century onwards. He explains that the ascent, which is difficult is to realize, is expressed by Clarissa who pleaded for compassion in The Face of Violence, showing we should never lose awareness of our humanity.

Bronowski traces the researches into the spectrum of electromagnetic radiation through the work of James Clerk Maxwell in 1867 who proposed that light is an electromagnetic wave, to radio waves “whose existence Heinrich Hertz proved nearly a hundred years ago in 1888 and so confirmed Maxwell’s theory” onto “the astronomer William Herschel [infrared rays] in 1800 and then to Wilhelm Konrad Röntgen who discovered x-rays” (Bronowski, 1973, p354–356). Bronowski points out that Röntgen’s work “was a finding in physics that seemed designed by nature to serve medicine. It made Röntgen a kindly father figure, and he was the hero who won the first Nobel Prize in 1901.” (Bronowski, 1973, p356).

While “x-rays will not show us an individual atom, because it is too small to cast a shadow even at this small wavelength, nevertheless we can map the atoms in a crystal because their spacing is regular, so that the x-ray will form a regular pattern of ripples from which the position of the obstructing atoms can be
inferred. This is the pattern of atoms in a DNA spiral: this is what a gene is like. The method was invented in 1912 by Max von Laue, and was a double stroke of ingenuity, for it was the first proof that atoms are real, and also the first proof the x-rays are electromagnetic waves.” (Bronowski, 1973, p356).

Bronowski goes on to discuss the “electron microscope, where the rays are so concentrated that we no longer know whether to call them waves or particles.....the smallest object that has ever been seen is a single atom of thorium. It is spectacular. And yet the soft image confirms that, ...... even the hardest electrons do not give a hard outline. The perfect image is still as remote as the distant stars. We are here face to face with the crucial paradox of knowledge. Year by year we devise more precise instruments with which to observe nature with more fineness ...... we are discomforted to see they are still fuzzy and we feel that they are as uncertain as ever ......” (Bronowski, 1973, p356).
And then Bronowski considers the "paradox of knowledge which is not confined to the small, atomic scale ... it is cogent of the scale of man, even of the stars." (Bronowski, 1973, p358). Bronowski thinks of Karl Gauss's work which I have referred to earlier in the thesis. Gauss came to recognize that individual observations are "as scattered within themselves as ever .... The scatter marks an area of uncertainty." (Bronowski, 1973, p358). This leads to the Gaussian curve of uncertainty, to which reference has been made elsewhere in the thesis. Bronowski and Gauss have a common bitterness towards philosophers who proclaim on nature without recognizing their own limitations in knowledge. Hegel was one such man who incurred the bitterness of Gauss and Bronowski. The relevance of the title of this segment, Knowledge or Certainty is thus seen by an awareness of the work of scientists so discussed from Maxwell on .... As Bronowski puts it "The errors are inextricably bound up with the nature of human knowledge." (Bronowski, 1973, p360).

Bronowski refers to an irony closer to our own time. Gauss as a young man studied at Göttingen University in 1795, and at the same university, quantum mechanics was the exacting topic in the 1920's, and the professors and students were unaware that outside this university, the dogma and rigidity of Hitler's Nazism was descending to blot out tolerance and open ended thinking. I will not discuss Göttingen or its renowned thinkers - Max Born, for example ......, since I have reviewed in chapter 5. I would only want to mention that Heisenberg's Principle of Uncertainty developed in this free atmosphere, to be named by Bronowski the Principle of Tolerance. As Bronowski says "All knowledge, all information between human beings can only be exchanged within a play of tolerance ... the Principle of Tolerance fixed once for all the realisation that all knowledge is limited."

As the segment moves to its close, Bronowski refers to physicists of the 1930's such as his friend Leo Szilard who had hoped to stop the development of the atomic bomb research and who like Bronowski after his experience at Hiroshima and Nagasaki and especially his visit to the death camp at Auschwitz, turned away from physics to study human specificity at the Salk Institute. Standing in the pool of the ashes of humans made numbers by the dogma of Nazism, Bronowski says "We have to cure ourselves of the itch for absolute knowledge and power. We
have to close the distance between the push button order and the human act. We have to touch people. (Bronowski, 1973, p374).

Bronowski's words "We have to touch the people." makes me believe that Cristine Russell was perceptive when she said that all of Bronowski's sixty six years went into The Ascent of Man. It is just as William Blake, the poet said, "Violence has a human face/Forgive a man his violence.", and as Clarissa pleaded in The Face of Violence compassion is the generosity of people towards each other, over their solitariness.

And I personally know the humanity in the phrase "We have to touch people." Throughout the first five chapters of the thesis my wife Elizabeth took a personal interest. She passed away after a six months illness, in March of the year 2002. When my friends, neighbours, and acquaintances meet me anywhere and they reach out with words, gestures, eye contact, letters, their humanity, their compassion touches me. My grief emerges with tears in my eyes.
6.12 *Generation upon Generation*

There is a sharp contrast with the generosity of spirit in segment 11, when Bronowski deals with *Generation upon Generation* in segment 12. The high level of biological technicality in his presentation of Gregor Mendel the naturalist and James Watson and Francis Crick biologists in the Double Helix Spiral strongly suggests that Bronowski had considerable discussion with the biologists of the Salk Institute. It is only in the latter part of the segment that Bronowski considers human specificity in biological - cultural interaction, in a style which is more like Bronowski himself.

Gregor Mendel, born Johann Mendel, a farmer's son, was given the name Gregor when he became a monk to "get an education" at the University of Vienna, but he did not do well. Bronowski says Gregor Mendel remained a "kitchen-garden naturalist." (Bronowski, 1973, p380) and "Mendel decided to devote his life to practical experiments in biology, in his monastery Mendel began his formal experiments about two or three years after he came back from Vienna, say about 1856.

![Figure 6.28 Photo of Mendel, P381](image)

Not unexpectedly as the "kitchen-garden naturalist", "The plant that he had chosen, very carefully, is the garden pea" (Bronowski, 1973, p383), Now Bronowski proceeds to show how Mendel's work set off another step in the ascent of man. I will discuss the general thinking and action of Mendel without the complexity of the botanical issues.
Mendel selected seven characteristics of the peas such as shape and colour of the pea seeds and Bronowski himself chose "to display tall versus short" (Bronowski, 1973, p383) to illustrate the hybrids. The issues that came forward from Mendel's study of the hybrids include fertilization of hybrids, dominant and recessive genes and heredity. In his report of his experiments, published in 1866, Mendel said "It is now clear that the hybrids form seeds having one or other of two different characters, and of these one half developed again the hybrid form, while the other half yield plants which remain constant and receive the dominant or recessive characters (respectively) in equal numbers." (Mendel in Bronowski, 1973, p385).

Mendel's report was treated with disregard because no one understood the work in 1868 and then two years after the paper was published in Europe "he was elected abbot of his monastery. And for the rest of his life he carried out his duties with commendable zeal, and a touch of neurotic punctilio." (Bronowski, 1973, p385).

Mendel died in 1884, and "a new abbot burned all Mendel's papers at the monastery" (Bronowski, 1973, p387). But his papers which had been published were read by several scientists in 1900 when the study of genetics was developing and the significance of Mendel's work was appreciated. Bronowski then explains why he called his segment 12 Generation upon Generation. Mendel's work was related to genetics, and the diversity of pea characteristics in his research, Bronowski relates to "Sex produces diversity and diversity is the propeller of evolution." (Bronowski, 1973,p388). Essential in sexual reproduction from the beginning of living materials is the gene and "The genes are made of nucleic acids. That is where the action is." (Bronowski, 1973, p390).

Bronowski's use of the word 'action' is appropriate in two ways. It characterizes the way in which "the message of inheritance is passed from one generation to the next" (Bronowski, 1973 p390) and it opens up the action of James Watson and Francis Crick. "How the message of inheritance is passed from one generation to the next" was discovered in 1953 and it is the adventure story of science in the twentieth century. This drama began in the autumn of 1951, when a young man in his twenties, James Watson, arrived in Cambridge, and teamed up with a man of thirty-five, Francis Crick to decipher the structure of deoxyribonucleic acid, DNA for short. DNA is a nucleic acid, that is, an acid in the central part of the cells, and it had become clear in the preceding ten years that nucleic acids carry the
chemical messages of inheritance from generation to generation. Two questions faced the researchers in Cambridge and as far afield as California. What was the chemistry and what is the architecture?" (Bronowski, 1973, p396). These are questions which follow on so well from Gregor Mendel's work with the characteristics of the garden peas.

Watson and Crick developed the "Model of the DNA molecule is a spiral staircase .... the spiral staircase in a gene, a gene in action, and the treads are the steps by which it acts." (Bronowski, 1973, p393). It is apparent now that the title for segment 12 "Generation Upon Generation" is expressive of the building up of DNA structure and hence the movement of genes.

Bronowski presents the details of Mendel, Watson and Crick's work, it in a very technical way, so that I wonder whether he presented what he was told by biologists, if not at Cambridge, then at the Salk Institute.

To summarize this second part of Generation upon Generation, Bronowski wrote "On 2 April 1953, James Watson and Francis Crick sent to nature the paper which describes this structure in DNA on which they had worked for only eighteen months. In the words of Jacques Monod of the Pasteur Institute in Paris and the Salk Institute in California:

"The fundamental biological invariant is DNA. That is why Mendel's defining of the gene as the unvarying bearer of hereditary trait, its chemical identification by Avery (confirmed by Hershey), and the elucidation by Watson and Crick of the structure basis of its replication invariance, without any doubt constitute the most important discoveries ever made in biology. To which of course must be added the theory of natural selection, whose certainty and full significance were established only by those later discoveries." (Bronowski, 1973, p393).

After Jacques Monod accepted "The fundamental biological invariant is DNA" (Bronowski, 1973, p393), Bronowski himself moves to an extensive discussion that "Ours [humans] is a cultural species" (Bronowski, 1973, p404) and brings the ascent of man forward as the imaginative, foresightful species who generates variety, as the previous segments have demonstrated, just as The Identity of Man and The Origin of Knowledge and Imagination have shown. This was discussed in
chapter 4 and 5 and poetical presentations in chapter 2 and 3. To develop the
discussion, Bronowski asserts “The baby is an individual from birth. The coupling
of genes from both parents stirred the pool of diversity, and chance has now
combined these gifts in a new and original arrangement. The child is not a
prisoner of its inheritance, it holds its inheritances as a new creation which its
future actions will unfold. The child is an individual.” (Bronowski, 1973, pp395,
400).

Bronowski is now back to his human specificity interest and he writes with even
more power when he deals with cloning, an issue of much concern and discussion
at the present time, 2002. Bronowski asks: “Should we make clones of human
beings – copies of a beautiful mother, perhaps, or a clever father? Of course not:
My view is that diversity is the breadth of life, and we must not abandon that for
any single form which happens to catch our fancy – even our genetic fancy.
Cloning is the stabilization of one form, and that runs against the whole current of
creation – of human creation above all. Evolution is founded in variety and creates
diversity; and of all animals man is most creative because he carries and expresses
the largest store of variety. Every attempt to make us uniform, biologically,
emotionally or intellectually, is a betrayal of the evolutionary thrust that has made
man its apex.” (Bronowski, 1973, p400).

I consider this to be one of Bronowski’s most eloquent statements of his belief
about what generates the ascent of man. It is evolution of complexity by stratified
stability. It links to Darwin, Wallace and Gauss. It is the capacity for knowledge
as against certainty. It reflected Galileo’s knowledge over the church’s certainty
and it touches those under Nazism who subscribed to Aryan certainty. It relates
the practical men of the Industrial Revolution, to the ethical poets such as Philip
Sydney or the romantics like William Blake and it includes the cubist painters.
Whatever students say about Bronowski’s gender bias referring always to “man”,
it allows women the dignity of their being, despite Bronowski commenting that in
the “myths of creation in human cultures [seem] almost to yearn back for an
ancestral clone. Although Eve is cloned from Adam’s rib and there’s a preference
for virgin birth, sex has a very special character for human beings. It has a special
biological character.” (Bronowski, 1973, p400) I will not develop this character
further since Bronowski in works such as “The Identity of Man” (discussed in
chapter 4), has characterized how “we are the only species in which the female has orgasms ....... We are the only species which copulates face to face.” (Bronowski, 1973, p400-401). What is important in these biological qualities of humans of all cultures is that men and women select each other for similar intellectual qualities, they can be more “quick witted” and able to produce our stone axes, shelters, foods, to urge along our cultural development. “Ours is a cultural species combining both biological qualities and cultural ....” (Bronowski, 1973, p404). Bronowski concludes the building of “Generation upon Generation” when he says “Spiritual and carnal love are inseparable. A poem by John Donne [1573 –1631] says that; he called it. The Extasie and I quote eight lines from almost eighty.

*All day, the same our postures were,
And wee said nothing, all the day.
But O alas, so long, so farre
Our bodies why doe wee forbeare?
This Extasie others unperplex
(We said) and tell us what we love.
Loves mysteries in soules doe grow,
But yer the body is his booke.*

(Bronowski, 1973, p406).

*Figure 6.29 Ludwig Boltzmann And His Wife Henrietta In 1875*

*Figure 6.30 James And Elizabeth Watson*
6.13 The Long Childhood. (The Future)

Segment 13, titled The Long Childhood can be considered as a review of all the previous segments, and the considerations contained in Bronowski’s beliefs about science and the arts. He begins by asserting that “...... justice is a universal of all cultures” which is a striking assertion considering the ups and downs in human ascent. It becomes clearer when Bronowski continues that justice “...... is a tightrope that man walks between his desire to fulfil his wishes, and his acknowledgement of social responsibility. No animal is faced with this dilemma: an animal is either social or solitary. Man alone aspires to be both in one, a social solitary. And to me that is a unique biological feature. It is the kind of problem that engages me in my work on human specificity, and that I want to discuss.” (Bronowski, 1973, p411). What comes to me as I ponder Bronowski is the volume Science and Human Values, discussed in chapter 4, where Bronowski was so passionate about presenting science as a communal activity, yet scientists are individuals.

Bronowski continues: “It is something of a shock to think that justice is part of the biological equipment of man. And yet it is exactly that thought which took me out of physics into biology ......” (Bronowski, 1973, p411).

Much of what follows now, Bronowski acknowledges he has considered in The Identity of Man – “Man is unique not because he does science and he is unique not
because he does art, but because science and art equally are expressions of his marvellous plasticity of mind." (Bronowski, 1973, p412). This is a fundamental belief held by Bronowski. Despite his distressing experiences such as the atomic bombing of Japan, the ineptness of governments, the intolerance of civic institutions, Bronowski still believes man is optimistic in his continuing ascent. *The Long Childhood*, the title of this segment is the long time that the learning process takes, back for example to caring societies such as Egypt and Rome.

Bronowski then goes on to consider "the brain as it is specific to the human creature." ...... and he asserts that "if we are any kind of machine, then we are a learning machine." (Bronowski, 1973, p416). What follows is a consideration of those parts of the brain "where it controls the hand, for instance, where speech is controlled, where foresight and planning are controlled." (Bronowski, 1973, p416). Another aspect of *The Long Childhood* is that the skull of the Taung baby has a brain which weighed a little over a pound, compared with "my brain, the average brain today weighs three pounds." (Bronowski, 1973, p415). So *The Long Childhood* has biological and cultural aspects.

There is a third aspect to *The Long Childhood* and that is the long time it has taken humans to learn that we can learn. To illustrate this facet of humans, Bronowski goes back further than Egypt and Rome, China and India to a nomad society of Uzbeki's in Afghanistan where the culture is "Static, because the son does what the father did, and the father did what the grandfather did." (Bronowski, 1973 p426-7).

*Figure 6.33 Photo of the Uzbeki's (P426).*
This aspect of *The Long Childhood* Bronowski goes on to consider in European society, illustrating his argument by referring to a monk who broke out of the "iron door closed against knowledge. Only when Erasmus read the classics for himself in defiance of orders, did the world open for him." (Bronowski, 1973, p427).

*Figure 6.34 Photo of Erasmus (P427).*

"Erasmus made two lifelong friends, Sir Thomas More in England and Johann Frobenius in Switzerland. From More he got what I got when I first came to England, the source of pleasure in the companionship of civilized minds. From Frobenius he got a sense of the power of the printed book..... What did those three men and their books mean? [Hippocrates, More's *Utopia*, Erasmus' *The Praise of Folly*.] To me, this is the democracy of the intellect ..... what More wanted to be, what Erasmus wanted to be, what every strong intellect wants to be, is a guardian of integrity." (Bronowski, 1973, p429). I think it is right to say that Bronowski himself in all his years since he arrived in England with his family in 1920, devoted himself to being a guardian of integrity.

Bronowski goes on: "There is an age old conflict between intellectual leadership and civil authority. In his own travels, Bronowski followed the path taken by Jesus "as he saw it [The Path] going to his certain death. Death, because Jesus was then the intellectual and moral leader of his people, but he was facing an establishment in which religion was simply an arm of government. And that is a crisis of choice that leaders have faced over and over again. Socrates in Athens;
Jonathan Swift in Ireland, torn between pity and ambition; Mahatma Gandhi in India, and Albert Einstein when he refused the presidency of Israel.

I bring in the name of Einstein deliberately because he was a scientist, and the intellectual leadership of the twentieth century rests with scientists. And that poses a grave problem, because science is also a source of power that walks close to government and that the state wants to harness. But if science allows itself to go that way, the belief of the twentieth century will fall to pieces in cynicism …….” (Bronowski, 1973, pp429-432).

This is powerful and highly relevant writing by Bronowski, because it goes back to his reactions to the atomic bombing in Japan, and led him to write “Science and Human Values” and to move from physics to biology. It was not the scientists of the Manhattan project who bombed Japan. Bronowski is clear that it was a decision by the US Government of the time. I am sure that Bronowski’s concern for cynicism has been responsible for his often repeated observation about the loss of nerve by the public in the twentieth century. This is no doubt still going on with the perception of scientists as bespectacled, white coated men.

Towards the end of segment 13 Bronowski devotes much discussion to the man who personifies these issues [democracy of the intellect, science and government] for him. Bronowski says “…. The man who personifies these issues for me is John van Neumann. He was born in 1903, the son of a Jewish family in Hungary …. he was a child prodigy of mathematics.” About his book “Theory of Games” says Bronowski to Neumann, “You mean the theory of games like chess.” “No, no”, he said, “Chess is not a game. Chess is a well defined form of computation.” (Bronowski, 1973, p432).

Neumann goes on “Now real games,” he said “are not like that at all. Real life is not like that. Real life consists of bluffing, of little tactics of deception, of asking yourself what is the other man going to think I mean to do. And that is what games are about in my theory.” Bronowski says Neumann’s book is heavy, so to speak, because it is covered with equations that look so very pompous … In the latter part of his life, John van Neumann carried this subject into what I call his second great creative idea. He realized that computers would be technically important, but he also began to realize that one must understand clearly how real-life situations are different from computer situations, exactly because they do not
have the precise solutions that chess or engineering calculations do.” (Bronowski, 1973, pp432-433).

Bronowski goes further in considering Neumann’s later years, but I feel I have given sufficient awareness of Neumann. The integrity of thought which Bronowski saw in Neumann sets the discussion with which Bronowski himself moves to a conclusion of The Long Childhood. He says “.... the ascent of man is always teetering in the balance .... knowledge is not a loose leaf notebook of facts. Above all, it is a responsibility for the integrity of what we are, primarily of what we are as ethical creatures. You cannot possibly maintain that informed integrity if you let other people run the world for you while you yourself continue to live out of a ratbag of morals that come from past beliefs.” (Bronowski, 1973, p436).

That view seems to justify all the work that Bronowski must have put into the making of the thirteen segments of The Ascent of Man. And despite the views of some academics about the BBC in televising the series which are related in chapter one, Bronowski’s views on ethics, the variability of the ascent is so much more powerful and penetrating when it is read as a book. This is important as a counter to the loss of nerve by the general public.

Bronowski himself says, “.... I am infinitely saddened to find myself suddenly surrounded in the West by a sense of terrible loss of nerve, a retreat from knowledge into – into what? Into Zen Buddhism; into falsely profane quotations about, are we really now just animals at bottom; with extra-sensory perception and mystery. ....... knowledge is our destiny. Self knowledge, at last bringing together the experience of the arts and the explanations of science, waits ahead of us.” (Bronowski, 1973, p437).

Perhaps the key word in all that Bronowski has related in the 13 segments is self. Not self centred, but self responsible. That sentence is what I have gained from The Ascent of Man. In fact, ‘self responsible’ is what I have gained from all the Bronowski writing that I have studied. Such responsibility is not easy to acquire as I have discovered after the loss of my dear wife Elizabeth early in 2002.

I will let Bronowski round off The Ascent of Man. He says in his final paragraph of the thirteen segments; “We are all afraid – for our confidence, for the future, for
the world. That is the nature of the human imagination. Yet every man, every civilisation has gone forward because of its engagement with what it has set itself to do. The personal commitment of a man to his skill, the intellectual commitment and the emotional commitment working together as one, has made the Ascent of Man.” (Bronowski, 1973, p438).

Figure 6.35 Photo of Blakes ‘Songs Of Experience’

Bronowski notes that the drawing of Blake comes from “The frontispiece of Songs of Experience by William Blake

To conclude this chapter, I offer this summary of the work. On the TV screen each segment of The Ascent of Man notes that the programme is A Personal View of Bronowski. It is fair to say that throughout his 66 years, Bronowski has spoken from his experiences, especially since his family – Bronowski is the eldest of three children – arrived in England from Poland via Germany in 1920.

From the days after he graduated PhD in Mathematics from Cambridge University, and he gave talks to Workers Educational Association meetings to the making of the TV series, Bronowski has enjoyed the English language, and the company of intellectuals, in England and America.

From the many messages in The Ascent of Man, I would select the expression “Evolution of complexity by Stratified Stability” because it characterizes how
human beings evolve in a biological – cultural context using words in patterns of language, imagination, foresight, hindsight to continually ascend oneself. By “stratified stability” I meant Bronowski means the development from nuclei to atoms to molecules to amino acids to reach proteins from which cells grow. (Bronowski, 1973, p42). And all the time in our lives we battle within the solitary-social needs within our lives.

Humans have plainly evolved from nomads such as the Uzbeki’s, to a village life developing agriculture on to city-states and nations. All the while individuals are interested or reactive to their surroundings. So in The Ascent of Man series, there are steps which enhance humanity and behaviour which denigrates humanity.

In the thirteen segments there are a wide range of persons in science, arts, practical industrialists who are building up and also those people who want to be destructive to evolution. Among the persons coming on the stage there are such as Galileo, Gauss, Newton, Einstein, Priestley, Pasteur, Bohr, Rutherford, Mendel, Salk, Clerk Maxwell, Mendeleev, Crick, Watson, Pythagoras, Euclid, William Blake the English Romantic Poet, industrialists John Wilkinson, Richard Trevithick, James Watt, more scientists Ludwig Boltzmann, Dalton, the modern Cubists painters Picasso, Seurat, to Darwin and Wallace. I have not put the names in historical order, but I have mentioned them as they came to my mind simply to illustrate the panorama of events in the programme.

And there are steps back: There was the Inquisition which the Catholic Church imposed on Galileo in the seventeenth century. In the twentieth century Hitler with Himmler and others of the Nazi regime imposed a destructive regime both biologically and culturally on a wide range of people and attitudes in Germany, and in Europe. Bronowski devotes much consideration to the concentration camps which deliberately reduced especially Jews to ashes, and to intellectual life amongst Germans themselves.

The phrase which Bronowski uses in The Ascent of Man which impressed itself on me is “democracy of the spirit.” We all have the potential, perhaps back at birth and early childhood to develop “a democracy of the spirit”, both within and without ie, outside ourselves. In essence, the ascent of man is the rise and fall of the democracy of the spirit, the flexibility and freedom to imagine, think forwards and backwards, to communicate in language in ourselves and between ourselves.
I conclude the chapter with a photograph of Bronowski, which was published by the Salk Institute Memorial Newsletter, after Bronowski’s sudden death from a heart attack in the latter part of 1974. He has always communicated himself to me during the work for the chapters of the thesis, as a kindly, scholarly man of quiet compassion.

THE SALK INSTITUTE NEWSLETTER

A SPECIAL TRIBUTE

To The Memory of

J. Bronowski

(1908 - 1974)

Figure 6.36 Dr Bronowski at home in his study February 1973
Chapter 7: Living is a Play of Values

7.1 Introduction.

Why should I want to continue a consideration of Bronowski's work after The Ascent of Man in chapter 6, and especially after his death in 1974? There are many people in physical science such as Gerald Holton and in biology like Cliford Grobstein who continued to consider Bronowski’s work and its impact on our times after 1974.

There are three persons in particular who have moved me to want to finalise my thesis with Chapter 7, The Visionary Eye. Essays in the Arts, Literature, and Science, selected by Piero E Ariotti, science and philosophy researcher and Rita Bronowski, sculptor, wife to Jacob Bronowski and mother of his four children who selected and edited the essays. Their significance is apparent as they developed. In addition, I have added, early in the chapter, a contribution by Reg Butler, sculptor, from A Tribute to Jacob Bronowski, 1908-1974, a collection of speeches given by Bronowski’s friends and colleagues in the Concert Hall, Broadcasting House, London. Butler said, “I think for very many millions of people Bruno will be thought of as an explainer. Certainly that is the way I think about him. And I think this compulsive need to order things, to explain them to people less gifted, was quite deeply an emotional thing in his personality. You see, I think he needed to explain, almost as if he were offering some kind of moral virtue, as though he were preaching a doctrine in which understanding and comprehension was a thing all men should aspire to.” (Butler, 1975, p9).
I think that Butler, perhaps unwittingly, is touching upon Bronowski’s Jewishness and his belief, to which I referred in Chapter 1, that Judaism involves an intellectual responsibility to offer any community of people the best knowledge that enhances the humaneness of that community. Also I think Butler would be referring to Bronowski’s statement, which he made as a young man, new to England, that he enjoyed the “company of civilized minds.” (Bronowski, 1966, p29).

In the second paragraph of this Chapter, I referred to Piero E Ariotti and Rita Bronowski, as well as Reg Butler. Ariotti and Rita Bronowski both “selected and edited …..” two volumes. Ariotti had principal influence in the science
lectures and essays from Jacob Bronowski in *A Sense of the Future*. Rita Bronowski showed her influence in *The Visionary Eye* in her Introduction, wanting to show her husband’s “bright ribbon of imagination.”

In her Introduction to *The Visionary Eye*, Rita Bronowski says, “In this collection of essays the theme of the imagination spins like a bright ribbon through the fabric of his thought ....” Rita Bronowski goes on to discuss Jacob Bronowski’s interest in human specificity but I will not record that aspect of her Introduction since it has been thoroughly considered earlier in the thesis. Rather I want to record Rita Bronowski’s explanation of the last six essays in *The Visionary Eye*. She wrote that the last six essays in this collection were given at the National Gallery of Art in Washington, DC, as the AW Mellon Lectures for 1969, with the overall title, *Art as a Mode of Knowledge*. These lectures were intended to compliment his Silliman Lectures, *The Origins of Knowledge in (sic) Imagination* (Yale University Press, 1978), which he originally planned to call Science as a Mode of Imagination ....” Rita Bronowski concludes her Introduction writing, “Jacob Bronowski will be remembered especially for his remarkable, authoritative grasp of both scientific and literary culture. It is hoped that these essays [*The Visionary Eye*] will serve as a fitting memorial to his extraordinary range, diversity and sensitivity”. (Rita Bronowski, 1978, ppvii-viii).

*Figure 7.3 Salk Institute President Joseph Slater at Dr Bronowski’s sixtieth birthday party January 1968, Rita Bronowski and Clare look on. (Salk Institute Memorial Newsletter).*
7.2 The Content of *The Visionary Eye*.

*The Visionary Eye* includes the following lectures:

**LECTURE**

Lecture No 1      *The Nature of Art*
Lecture No 2      *The Imaginative Mind in Art*
Lecture No 3      *The Imaginative Mind in Science*
Lecture No 4      *The Shape of Things*
Lecture No 5      *Architecture as a Science and Architecture as an Art*
Lecture No 6      *Art as a Mode of Knowledge*  
                  (The AW Mellon Lectures in Fine Arts for 1969)
Lecture No 6.1    *The Power of Artifacts*
Lecture No 6.2    *The Speaking Eye. The Visionary Ear*
Lecture No 6.3    *Music, Metaphors and Meaning*
Lecture No 6.4    *The Act of Recognition*
Lecture No 6.5    *Imagination as Plan and as Experiment*
Lecture No 6.6    *The Play of Values’ in the Work of Art*

The contents of each of the lectures is considered in some detail.

7.3 *The Nature of Art*

In this essay, which Rita Bronowski chose as an example of the “bright ribbon of imagination” of her husband, is also the beginning essay in his book *The Poet’s Defence* (1966 ed.) which formed Chapter 2 of my thesis. Both the opening essay and the contents of *The Poet’s Defence* dealt with the timeless experiences of poets, and led Jacob Bronowski to understand not only the poets in the book itself from Sir Philip Sidney on, but especially the idealism and also the realism of William Blake.

The characteristics of all qualities in art are “the symbols and voice of universal experience more lasting than the accidents of time.” (Bronowski, 1939). This belief of Bronowski, stated in the 1939 ed., evolved and expanded right up to the time of his death. Whether scientists or artists, the experience of
the artifact came from inside, both in the creator and in the receiver. This, Bronowski asserted in the beginning. “Truth that is direct and absolute and unique” comes from the inside of the person. He was referring to the fact that as a Cambridge undergraduate, and then as a graduate mathematician, “I had of course spent much of my time in the company of scientists. They talked vigorously about scientific work, their own and that of others ..... they even talked about the philosophy of science which was struggling with the daring ideas of relativity and quantum physics. They spoke as equals about the labours turning into fact what the imaginative mind conceives, and they spoke about the labours and the minds of the great and small as if they were their own, from the inside ..... it was never magisterial: no one ever thought about laying down the law to alter scientists. To be a critic was not and is not a scientific profession.” (Bronowski, 1966, p1).

Continuing this extract from his 1966 preface to *The Poet's Defence*, Bronowski contrasts the students and practitioners of science with the literary students and critics. He says, “They crowded the lecture of IA Richards, later of FR Leavis, and then went home to analyze the poems in the manner of the masters ..... it was by nature and method the analysis of the outsider” (Bronowski, 1966, p1).

Bronowski, himself as a reaction to the literature “outsiders”, which he described as the students at Cambridge “turned to the criticism written by the poets themselves. I was looking not so much for a criticism as for a philosophy of literature. The philosophy I found in the writings of the poets about themselves, and put in my book, *The Poet's Defence.*” (Bronowski, 1966, p2). This is the reason *The Poet's Defence* is appropriate to illustrate the essay *The Nature of Art.*

As presented in chapter 2 of the thesis, Bronowski concluded his study of eight poets from Philip Sidney to WB Yeats, by saying that the “best poets ..... have access to a kind of truth that is direct and absolute and unique. For them and in them, literature was absolute, profound and immediate form of universal knowledge.” (Bronowski, 1966, p2).

Bronowski went on to say that he was “naturally chagrined by the immobility of opinions amongst critics” in their study of his belief in the universality of
knowledge of the eight poets he had studied. He took what he called "an empirical test" to present a convincing argument as to his belief about poets writing from the inside of themselves.

Bronowski chose the period of the Industrial Revolution in England, intending to contrast Alexander Pope and the Augustan poets before the Revolution with William Blake during and after it. The circumstances of World War Two led him to limit himself to the publication of *William Blake and the Industrial Revolution*, which formed Chapter Three of this thesis.

It is through Bronowski's in-depth and intense study that he wrote, "It is the belief of imaginative poets, of whom Blake was among the first, that they are the symbol and the voice of universal experience, more lasting than the accidents of time, ..... poetry does speak from one age to another, because it is founded in experiences which are simply common, profound, which are human and universal. But alas! to the generations from Belsen now and Peterloo then, the timeless human experiences do not end at love, beauty, truth and passion. They embrace poverty and fear and injustice and chicane, the loss of place and social disasters." (Bronowski, 1966, p5).

Bronowski concludes lecture 1 on *The Nature of Art* when he says, "..... there is one deep question to answer. How is it that the poem can pass these grave truths from the poet to the reader directly? What is it in literature that makes it able to communicate not simply by pleasure but knowledge? Allen Tate in *The New Republic* pointed to this as the crucial problem that *The Poet's Defence* posed. "Bronowski is saying that unless epistemology can ask real questions, then poetry becomes as unreal as philosophy; there remains only sensation for poetry and the empirical method for science." Bronowski himself says, "I have pursued this ever since, in writing about science and philosophy as well as about literature, ..... I have no doubt there is a common quality in science and in poetry, the quality of imagination. But I have no doubt either, thirty years after *The Poet's Defence* was written, that what I held then is true: the imagination reaches us, reaches into us, in different ways in science and poetry ....." (Bronowski, 1967, p5).

I will not write out the different ways that Bronowski refers to, since lectures 2 and 3 to follow are concerned to explain the ways.
7.4 The Imaginative Mind in Art.

From the collection “Imagination and the University (1964)”

Bronowski explains: “I have used the word “Imagination” in the title of this essay and in the next because it is the right word to describe the most human gift. Imagination simply means the human habit of making images inside one’s head” (Bronowski, 1966, p11).

Bronowski sets the boundaries of lecture 2 when he begins by saying, “The art from which I shall draw most of my illustrations is literature, and more particularly poetry. I choose the field of literature because it has the advantage that the raw material is simply words ….. Literature begins with language and it is relevant to begin by saying something about the history and nature of human language.” (Bronowski, 1964, p6).

Bronowski continues, “….. human speech is probably not much older than a hundred thousand years ….. . There is a certain likeness between human language and animal language.” (Bronowski, 1964, p6).

Now Bronowski discusses at length the language of bees by describing the dance of bees, but since I recorded Bronowski’s account of bee language as characteristic of animal language in chapter 5, I will not repeat what he says.

While acknowledging that humans also have a language of instruction and information, he elaborates the discussion: “But human beings also use language for quite a different purpose; for personal reflection and elaboration ….. We reflect on our own ideas, we change them and analyze them, and they carry our personal association for us. It is words in this sense which are the vehicles of our imagination, and the raw material of literature. ….. Probably the images that we use most often in the mind are the words themselves.” (Bronowski, 1964, pp8-9).

What comes to my mind are the “Auguries of Innocence” of William Blake:

A Robin Red Breast in a cage
Puts all Heaven in a rage

where I and others relate from the bird in a cage to the idea of the wrongness of constricting people in their natural need for freedom in life.
Bronowski offers another vital human quality: “Friendship is a characteristically human attribute. Only humans are capable of projecting themselves into imaginary situations, and considering a week ahead. ‘If it snows I’ll have to wear my galoshes, but if it doesn’t snow I’ll be able to wear my new shoes.’” (Bronowski, 1964, p11).

Continuing his discussion, Bronowski states, “the ability to make images for absent things, and to use them to experiment with imaginary situations, gives man a freedom which other animals do not possess. That freedom has two distinct parts. One part is the pleasure that human beings feel in trying out and exploring imaginary situations. A child’s play is concerned with this pleasure [playing doctors and nurses] and so much of art, and much of science too. At bottom, pure science itself is a form of play in this sense. (Bronowski, 1964, pp11-12).

Then Bronowski says, “The second part of the freedom which words and images give us is that they are personal to us ….. This personal manipulation of language, this gift of recreating for ourselves, in a fresh way, the images which other people present to us, are the foundations of art. When you read a poem you all see the same words, and yet each of you makes the poem something different and personal for himself.” (Bronowski, 1964, p12).

Now to consider the art itself, to paraphrase Bronowski. “Let us consider the following poem by Dylan Thomas (1914-1953):

\[
\text{The force that through the green fuse drives the flower}
\]
\[
\text{Drives my green age, that blasts the roots of trees}
\]
\[
\text{Is my destroyer.}
\]
\[
\text{And I am dumb to tell the crooked rose}
\]
\[
\text{My youth is bent by the same wintry fever}
\]

(recorded by Bronowski, 1964, p12).

The poem which is untitled has 3 more stanzas which I will not record since all 4 stanzas contain the same ideas. Like Bronowski, I find the first stanza has sufficient power to explain the poetic art of Dylan Thomas.
Bronowski says, "..... the central thought here is simple. It consists of the confrontation in each verse of the same two ideas. One is the idea of the green fuse, the power in nature that drives everything forward. The second idea in each verse is that we are however, being destroyed by this very same power. We are getting older, life and time are killing us a little with each experience ..... the predicament of all living and growing things." (Bronowski, 1964, p13).
But Bronowski says, “..... I did not choose this poem in order to discuss its philosophy. I chose it to illustrate the nature of human language ..... The poet must take pleasure in discovering what language can do: that is his starting point. And this sense of pleasure is obvious in the poem; it is obvious that Dylan Thomas was not merely in love with poetry, he was in love with words. ..... the poem itself is rich in meaning because everyone makes his or her own poem out of it ..... I am captured by the word “fuse” in the first line and its explosive urgency carries me headlong in the poem from the beginning ..... if you want to understand the poem you have to recreate it for yourself ..... You must recreate the work for yourself – it cannot be presented to you readymade.” (Bronowski, 1964, pp13-14).

Bronowski illustrates this view when he says that the thought that “seizes” him is “that when you are young, growing older is wonderful, but when you are old, growing older is tragic.” (Bronowski, 1964, p15).

Bronowski illustrates his reaction to the poem saying, “When Dylan Thomas says, in his first verse [the verse I selected], that the sap which pushes through the branch to burst into leaf and flower is also the force that bursts the roots, he is not merely making my (Bronowski’s) prose statement more vivid. He is joining one area of experience to another, and illuminating and enriching each with each.” (Bronowski, 1964, p15).

I do agree with Bronowski when he says the “metaphorical figures of speech are imaginary and set off our own imagination.” (Bronowski, 1964, p15).

I have seen in my garden the power of the green fuse that Dylan Thomas refers to, in my plants such as jades, both grow hugely yet in doing so push against the garden wall and crack the brickwork. In a mundane way, I recall Sigmund Freud asserting we have Eros and Thanatos in ourselves and as we grow with the power of Eros, so slowly Thanatos can take over. I see this in my cat as she enjoys her life in the garden, she also, as she ages, now fourteen years, sleeps more. There are more personal and sensitive examples of the effect of the green fuse, but since I have given the examples earlier in the thesis, I will not repeat them. It is Bronowski’s argument, that linking together all the experiences set off in a person by the poem, creates the individuality of art.
Not only does the work of art give the recipient the freedom to be personal, Bronowski also points out that, "The ability to foresee several different courses of action and to weigh them in the mind might be thought to be a purely logical and scientific faculty. But in fact, this is the nature of all imagination in art and science alike." Referring to the poem Bronowski says, "..... the poem is deliberately arranged to prevent you from making up your mind." (Bronowski, 1964, p17).

Bronowski calls upon the poet Robert Frost’s work, Provide, Provide to illustrate his “final point ..... It is not a lyrical poem ..... It is tough and searching and an extraordinary poem.” (Bronowski, 1964, p19).
I have discussed Robert Frost's *Provide, Provide*, earlier in the thesis, so all I shall say that it is about a woman who was a Hollywood star who, with age, degenerates into

*The witch that came (the withered hag)*

*Towards the steps with pail and rag*

*Was once the beauty Abishag*

and Frost advises, “Do not become a fallen star: provide for your survival, whatever its cost, by any means at all, however mercenary, flamboyant or tawdry.” (Bronowski, 1964, p18).

Bronowski concludes that, “Robert Frost with a macabre sense of humour pretending to teach a lesson which he does not want us to learn. Here [his] imagination explores the alternative of human action without even deciding for one rather than the other. And in this tense and happy indecision, [as with Dylan Thomas] and only in this, the work of art is profoundly different from the work of science.

In the next essay I shall consider the great likenesses between art and science, which are to be set against this single difference.” (Bronowski, 1964, pp18-19).
7.5 *The Imaginative Mind in Science*

Bronowski begins: "This essay is a continuation of the preceding one, its theme is to draw not the differences but the likenesses between the imaginative faculty in art and science." (Bronowski, 1964, p20)

In effect, Bronowski wants to show that science runs through all our lives. He says, "Science uses images, and experiments with imaginary situations, exactly as art does..... To believe otherwise, to suppose that science does not need imagination, is one of the sad fallacies of our laggard education." (Bronowski, 1964, p20).

As I pointed out earlier in the thesis, my own education in science, at school in the 1930's was just that, "laggard" and it is only my studies of Niels Bohr and Jacob Bronowski which have shown me that science is an imaginative activity, just as art is.

Bronowski goes on to consider the effect of the "laggard" education in science. "Many people believe that reasoning, and therefore science, is a different activity from imagining. But this is a fallacy, and you must root it out of your mind ..... You may have been told, you may still have the feeling that E=mc^2 is not an imaginative statement. If so, you are mistaken. The symbols in that master equation – the E for energy, and m for mass, and c for speed of light – are images for absent things or concepts, of exactly the same kind as the words "tree" or "love" in a poem. The poet John Keats was not writing anything which (for him at least) was fundamentally different from an equation when he wrote,

*Beauty is truth, truth beauty – that is all
Ye know on earth, and all ye need to know.*

There is no difference in the use of such words as "beauty" and "truth" in the poems and such symbols as "energy" and "mass" in the equation," (Bronowski, 1964, p21).

Bronowski describes the kitten playing with a ball of wool, the children playing at doctors, nurses and patients as examples of animals learning to flex their muscles and children learning to feel their intellectual muscles. "The word experiment is an exact description of what the child is doing. And this
then the basic word in science, is also an exact description of what the adult
does whenever he is doing anything original at all ..... Both physicist and poet
try to find [their] way through human situations which [they do] not wholly
understand. Both are learning by experiment. And both are experimenting
with situations which they must imagine before they can create them. "What is
now proved was once only imagined" said William Blake. (Bronowski, 1964,
p22).

Because of the "laggard education" many people do not find it as pleasurable
to read a theorem as a poem "..... [but] science or art, every creative activity is
fun. ..... It is not possible to conceive a universe in which important creative
activities are not pleasurable." (Bronowski, 1964, p23). As he has often said,
"..... no creative work in art or in science, truly exists for us unless we
ourselves help to create it. That was the theme of the companion essays on the
arts and it is just as valid and as important for the sciences." (Bronowski,
1964, p23).

Bronowski now comes to parallel Dylan Thomas, when he says, "In the last
essay, I illustrated the power of language to evoke many different responses
by quoting a poem by Dylan Thomas. So it is appropriate that I should discuss
our responses to the language of science by choosing as my practical example
once again a poem. The poet is William Empson. He and I were students
together at Cambridge in 1920's, during the remarkable time when physics
was transformed by new discoveries and new theories in a few years."

Bronowski said he and William Empson, "edited a literary magazine called
Experiment and that title itself says something about the way that we wanted,
almost without thinking, to carry the language of science into literature ....."
(Bronowski, 1964, p25).

"William Empson's poem is called, To an Old Lady, ..... it is concerned with
the process of growing old, and the hardening of human habit into elderly
ritual. ..... The main metaphor, that runs all through the poem, pictures the old
lady first living on another planet, and then as being herself another planet."
(Bronowski, 1964, p25).
As Bronowski notes, the metaphors of William Empson’s poem are quite unlike Dylan Thomas’ nature or Robert Frost’s Hollywood star, but are concerned with the process of growing old in a distinctive way. Empson’s poem runs to six stanzas and I will set out the first stanza:

*Ripeness is all, her in her cooling planet
Revere, do not presume to think her wasted
Project her no projectile, plan nor man it;
God’s cool in turn, by the sun long outlasted.*

As Bronowski says the poem describes a “dignified old lady”, given by “Ripeness is all” and “cooling”, “growing old.”

Later in the poem there is the line

*Confident, finds no confines on her sphere*

and Bronowski points out, “There is a small verbal play here between ‘confident’ and ‘confines’ which we all catch. But the heart of the metaphor comes from mathematics: it is the theorem that a surface can be finite in extent, and yet if you or the old lady walk all over it you will never meet any boundaries and will seem to be going on to infinity. This is the language of science that most of us lack: not the technical words, but the simple basic ideas like the one that I have just explained. ….. The wealth of a language lies not in its words, but in the metaphors and associations which they stir in our mind. And these metaphors, these associations, are of ideas. If we fail to recreate it for ourselves, [as in Empson’s poem] it is because we are not at home with the basic ideas on which it stands.” (Bronowski, 1964, pp27-28).

So important is it to Bronowski to explain that the mind in science is imaginative, to rearrange his essay title, that he continues, “Many people think that the ideas of science are highly abstract and can only be expressed in formal equation. That is yet another popular fallacy. At bottom, no fundamental ideas, in any subject are abstract. The human mind works with images, and even its most subtle ideas have to be composed from images. ….. the whole of science is shot through with metaphors, which transfer and link one part of our experience to another, and find likeness between the poets. All
our ideas derive from and embody such metaphorical likenesses.” (Bronowski, 1964, p28).

These references to images and metaphors and likenesses to integrate the parts is genuine Bronowski as he believes, not only in science discussion, but as a fundamental human specificity.

Bronowski gives as an example, from about 1929, the work of Edwin Hubble, the American astronomer. Bronowski says he will discuss Hubble’s work “in detail” and I have selected six essential aspects of Hubble’s work.

Hubble noticed that, “the light from a distant galaxy looks redder, the further away the galaxy is from us ..... if the spectrum left a distant galaxy looking as it does on earth, what shifted it to the red on its journey? We cannot be certain,” says Bronowski. “No theory of science is certain, for every theory is an imaginative extension of our experience into realms which we have not experienced. ..... we [can] assume that light travels to us from a distant galaxy in the way in which a wave travels.” (Bronowski, 1964, p29).

Now drawing on the discovery of the “Austrian physicist, Christian Johann Doppler, that sound reduces in wavelength as it moves away from us (Doppler noticed the sound of a train whistle as the train moved away, went lower).” (Bronowski, 1964, pp29-30).

“Hubble”, says Bronowski, “made the same bold analogy ..... that the reddening galaxy is flying away from us ..... the galaxies are all flying away from us ..... Today we say that if the galaxies seem to be flying away from us, they must be doing something more universal: they must all be flying away from one another.” (Bronowski, 1964, p30).

Bronowski’s continuing account of Hubble’s work has an air of excitement and amazement about it. Bronowski asks, “Can we conceive, that is, a universe which is expanding as a whole? What we are trying to picture here is the whole of space expanding - and yet not expanding into anything: simply expanding. A universe which is finite but unbounded, like the surface of a sphere, could do that. But it can do it in your imagination, you can recreate the thought in your mind, only if you are willing to understand what the surface of a sphere is like. Arthur Eddington and Albert Einstein took Hubble’s idea on
to this last splendid conception of an expanding but finite universe of relativity. And if that fires your imagination too, then there will fall into place with a triumphant sound the line from William Empson’s poem To an Old Lady:

Confident, finds no confines on her sphere.

(Bronowski, 1964, p30).

In his account of Hubble’s work with Doppler, Eddington and Einstein, Bronowski has wanted to show “..... that the ideas of sciences embody a strong and strongly intertwined imagery, which can help us to recreate them for ourselves such as we recreate a poem or a painting. (My emphasis). And, second, in order that I may finally discuss one remaining question about science and art which is constantly asked. Must not a scientific theory be true and may not a work of art be quite untrue?” (My emphasis) (Bronowski, 1964, p31).

Bronowski answers his question by correctly saying (as I understand) that science is thought to be true in the popular mind “because it counts, measures and exactly describes the facts ..... But this definition of science is mistaken ..... Inside this cage of facts and evidence, the theory [in science] is a structure which we judge by its inner connections, its cohesions and its ability to fit the facts with the most beautiful economy of ideas” (Bronowski, 1964 p31).

An artistic and poetic description by Bronowski! In further description Bronowski links essays 2 and 3 on the imaginative mind in art and science when he writes: “All created works, in science and art are extensions of our experiences into new realms ..... The work of science or of art moves us profoundly, in mind and in emotion when it matches our experience and at the same time points beyond it. This is the meaning of truth .....” (Bronowski, 1964, p32).

Bronowski comes to the end of essay 3 with a poem of his own! “The theme of the poem is the connection between what happens to each of us individually and how the universe behaves as a whole. No one says the poem stands apart from the cosmic process as a whole; the great movements of the universe enter and extend into our specific and individual acts.” (Bronowski, 1964, p32).
In those descriptive lines, there is *The Face of Violence* with Clarissa’s plea for compassion to bring us together, there is Bronowski standing in the pool of ashes at Auschwitz and pleading that we reach out and touch each other, and there is the biology of the Salk Institute and Bronowski’s human specificity.

And with Dylan Thomas’ poem and William Empson’s poem, I will set down the first stanza of Bronowski’s poem. Before recording the stanza there is Bronowski’s account of the images: “..... one of the images that runs through the poem is the shift of the spectrum of distant galaxies towards the red which I have described. And it happens also that the poem was written at Christmas, and came into my mind when, standing beside the tree, I saw the red veins in my hand like branches:

*Faster than light and cold as absolute,*

*The edge of darkness races in pursuit*

*Of this expanding leaf, this Christmas tree*

*Of veins in which I hold the galaxy.*

*It is my hand, from which there streams and rips*

*The cosmic shift, red to the fingertips,*

*And what that flying shadow hunts is me.*

### 7.6 *The Shape of Things*

*The Shape of things:* was written for the London Observer in 1952. Bronowski begins by putting his views in perspective: he says: “Though I am a mathematician I have been occupied for several years with the problem of aesthetics ..... I do not regard aesthetics as a remote and abstract interest. My approach to aesthetics is not contemplative but active. I do not ask, “What is beauty?” or even “How do we judge what is beautiful?” I ask as simply as I can, “What prompts men to make something which seems beautiful to them or to others?” (Bronowski, 1952, p33).

Bronowski considers his view a rational one and “deserves a rational answer ..... A rational aesthetic must start from the conviction that art (and science too) is a normal activity of human life.” (Bronowski, 1952, p33).

This response about “a rational aesthetic” links this essay, published though it was in 1952 with essays 2 and 3 in *Imaginative Mind in Art* and *Imaginative
Mind in Science written much later, and confirms my belief that Bronowski’s concepts of human specificity, ie, how humans are, and were linked together, evolved far back in Bronowski’s life, even perhaps before his Cambridge days. As I have said earlier in the thesis, it is a real loss that he died before he wrote his autobiography.

In any event, Bronowski takes the origin of the rational aesthetic right back to cave paintings and stone tools: “What the painter and the inventor were doing right back in the cave, was unfolding the gift of intelligent action.” (Bronowski, 1952, p33).

Whereas animal behaviour is “fixed,” a term Bronowski uses meaning instinctive action, and examples of this have been given in earlier chapters such as the bees and their dance (Chapter 5), “man has freed himself from this dominance in two steps. First, he can remake what is out of sight ..... And second, the practice of speech allows man to become familiar with the absent situation ..... To my mind the cave paintings as much as the chipped flint tool is an attempt to control the absent environment ..... they are exercises in freeing man from the mechanical drives of nature.” (Bronowski, 1952, p34).

Bronowski then summarizes his aesthetic: “I have put the central concept of my aesthetic: evolution has had, for man, the direction of liberty ..... it is not the thing done or made which is beautiful, but the doing. If we appreciate the thing, it is because we relive the heady freedom of making it. Beauty is the by-product of interest and pleasure in the choice of action.” (Bronowski, 1952, p34). [My emphasis].

Long before the Salk Institute days, evolution was an essential concept in Bronowski’s perception of human living. Bronowski comes now to relate this background discussion of the rational aesthetic to the title of the essay The Shape of Things when he says, “they have a special relevance to industrial design.”

Bronowski moves to the era of the Industrial Revolution, which he recounted in William Blake and the Industrial Revolution” and to the iron masters John Wilkinson and Abraham Darby, the former making the first iron boat, had his own coffin made of iron and minted his own currency for the workers. Darby
made the parts for the Ironbridge in Shropshire and earlier in the thesis I have included a photo of the graceful semi-circular arched bridge, “a modest technical advance”, as Bronowski described it and a “break with centuries of timber or stone, and brick”. Wilkinson’s contemporaries felt, that the iron bridge was a true enlargement of human freedom. (Bronowski, 1952, p35).

Taking this theme further, Bronowski says “In our century, a succession of bold thinkers have built new bridges, first in reinforced concrete and then in prestressed concrete. What they have made has been useful and beautiful together, an enrichment which step by step has opened the potential of nature to us – the potential of human use and the potential of human appreciation together.” (Bronowski, 1952, p38).

I have given emphasis to the two words “use” and “appreciation” since they express the reason why Bronowski would write an article on The Shape of Thing” – how things are shaped depends upon their use, eg. the bridge and so whether there is beauty and appreciation. Bronowski anticipates the next essay 5, Architecture as a Science and Architecture as an Art. I like to think that his wife Rita was sensitive to these connections when she put the essays in the order in which they came. After all, she was a sculptor.

Bronowski continues: “There are people who acknowledge this physical explanation but who refuse to see in it what I also stress, that growth of the mind and widening appreciation have come with a scientific society. To them the technician is a gadgeteer .....” (Bronowski, 1952, p35).

Bronowski, rightly I think, says “Both [ie technician and artist] must share, both must enter into all the knowledge of their time. Knowledge which another man says is always constraint: every addition to your own knowledge is a liberation” (Bronowski, 1952, p38). By this Bronowski means that each man must listen to the other for mutual development of knowledge.

This reminds me of Bronowski back in Cambridge, aware as he wrote in The Poet’s Defence, of the artist, the student of literature just following his poetry critic and the scientists and the students of science turning aside from literature.
In contrast to the bridge, canals, railways of the earlier times of the Industrial Revolution, Bronowski comes up to our own times when he says, "The deepest changes in the habits of Europe and America in the last hundred years have been made by the increasing use of electricity." (Bronowski, 1952, p37).

I would like to add here, the use of electricity has expanded into the Middle East and Asia and Africa and the South Pacific. Bronowski lists various electrical items: "The dynamo, the electric motor, the switch and the valve, the telephone and the thermostat, the vacuum cleaner and the refrigerator have changed our ways of living. The electric light has added to the life span and, yes, to the culture of Western peoples, simply because it has made their day longer." (Bronowski, 1952, p37). Since 1952, television and information technology equipment has profoundly influenced the shape of human culture. I use the work ‘shape’ meaning the relationships among individuals, clans, tribes, states and nations. In Bronowski’s terms, he says; "..... the coming of electricity has set some of the most interesting problems in domestic design, because the artists who have solved them have taken pleasure even in the technical difficulties [Bronowski means voltage, load factor, insulation], they have done much to form the taste of our age." (Bronowski, 1952, p37).

Bronowski characterizes the practices of the technician and the designer as "industrial design. The object to be made is held in the triangle of forces. One of these is given by the tools and the processes which go to make it. The second ..... by the materials from which it is to be made. And the third ..... by the use to which the thing is to be put.” (Bronowski, 1952, p37).

It is readily seen by a diagram: "The factors that shape things." The triangle is the shape I used for convenience; it has no other meaning.
"If something is made when the process falls outside the triangle process, that will be bad, but within, alas, it will not necessarily be good. The triangle is not a point, and does not help us to prefer one point in it, one acceptable design to another." (Bronowski, 1952, p38).

Bronowski continues: "The search for the principles of good design is bedevilled when it tries to range through all the industries at once. For there is a difference between two kinds of industry – the traditional industries and the pioneer industries." (Bronowski, 1952, p38).

In moving towards a clear, definitive distinction between the traditional and pioneer industries, Bronowski lists again the variety of "simple, household things which have been pioneers in the last fifty years ..... electrical equipment ..... from the pocket torch to the refrigerator. Go on to the gas cooker and the controlled solid fuel cooker, to the mixer and the telephone, the radio and the television. And beyond these consider the things which have been at the head of technical progress: the motor car, the airplane, the calculating machine and the electronic devices which serve it." (Bronowski, 1952, p39).

Bronowski focuses especially on a pioneer industry the airplane: "..... the new problem, the unheard of adventure of flying through the air, influences design in two ways. First ..... it liberates the designer from convention and second, it
comes nearest to determining of itself the logical structure and with it the shape of the thing made. This is why the pioneer industries are leaders of design: because we sense that the things they make conform not to history but to logic.” (Bronowski, 1952, p39).

Bronowski goes on to the essential feature of products of the pioneer industries: He says, “The logical relations imply certain spatial relations; above all, they imply that the impartial element in the designs shall be the shape.” (Bronowski, 1952, P40).

As examples Bronowski gives the stretch of rubber because its atoms are strung out in chains, the stretch of diamond does not because the atoms are locked in a closed pattern of rings. “The most striking example of this geometrical way of thinking, as it were, is in the researches of the last years on the nature of life itself.” (Bronowski, 1952, p41).

Bronowski has often remarked that after the work on the atomic bomb had been completed, the interest of the scientific society has moved to biology. Bronowski himself moved to the Salk Institute and expanded his interest in “human specificity”.

Bronowski gives an account of, “our first inkling in recent work on the structure of the nucleic acids which are important in all living things. A molecule of nucleic acid consists of a pair of spirals each wound round the other and held to it by cross-links.” (Bronowski, 1952, p41).

Bronowski is referring to the DNA discovery, to which he gives full attention in The Ascent of Man produced some 23 years later, when the work of Watson, Crick and Rosalind Franklin, she was known as “The Dark Lady of DNA” emerged as part of everyday life in society. The Double Helix spiral would have gratified Bronowski’s interest in topology in mathematics way back to his Cambridge years. As he says, “These examples illustrate that in our society we express logical relations as structure and shape. The interest of the industrial designer is part of our whole society, and in the pioneer industries, he leads this interest.” (Bronowski, 1952, p41).

The next lecture on Architecture as Jacob Bronowski developed and organised it, is well placed by Rita to follow The Shape of Things.
7.7  Architecture as a Science and Architecture as an Art

At first reading of the Title of lecture 5, one might wonder what Architecture has to do with the Nature of Aesthetics. In fact, this subject connects well with essays 1 to 4, discussed previously, and it relates to The Shape of Things, especially the triangle of materials, and the use of tools and processes.

The lecture was delivered by Bronowski to the Royal Institute of British Architects in 1955 and published in the Institute’s Journal. Bronowski is firm, almost blunt in parts in the presentation of his views. I think his bluntness reflects his disappointment with the dreary, unimaginative council flats, office buildings, atomic power stations and electric power stations which are so devoid of imaginative liberty in their shape, as he saw them in England.

In introducing his interest to his audience, Bronowski acknowledges that “I am not an architect and I cannot instruct you either in the science of architecture or in its art.” (Bronowski, 1955, p45).

For his starting point, Bronowski says he “read the title backwards, as it were – literally so, for I begin with art; this is at the bottom, to be an essay about aesthetics.” (Bronowski, 1955, p45).

Bronowski makes it clear that to him aesthetics is “not contemplative but action. I do not ask, “what is beauty?” or even “How do we judge what is beautiful?” I ask as simply as I can, “What prompts man to make something which seems beautiful to them or to others?” Bronowski emphasizes that, “Nothing but confusion and damage results if art is thought as a mystic communion ….. art contains many elements, and mystery, sentiment and evocation are certainly among them. But if we give them a commanding place the result is disastrous: it is the posturing poetry of Tennyson, the nineties, and TS Eliot: Pre-Raphaelite painting and George Watts and the kleptomaniac architecture of Alfred Waterhouse and Edwin Lutyens leading inevitably to the Tudor pub and the Alhambresque cinema.” (Bronowski, 1955, p46). A powerful statement of the artificiality of art when it departs from a rational aesthetic.

No doubt, Bronowski was a man of the strongest convictions on rationality in the perception of art, and science too. These convictions infuse all his thinking.
as I trust the overall view of my thesis shows. A clear assertion from Bronowski’s *The Crux of a Rational Aesthetic* is, I believe, the conviction that art (and science too) is a normal activity of human life.” (Bronowski, 1955, p46).

Bronowski apologises to his audience and his readers: “You will forgive me for still remaining far from architecture. My reason is that architecture is a complex art, one of the peaks in man’s exploration of nature (including his own nature).” (Bronowski, 1955, p47).

Bronowski discusses the compulsions of animal behaviour, which I will not review again, the essence of the animal behaviour being its companions (food and water) which hold it and, says Bronowski, “This is where man as we know him has always lived in another world – a world with an added dimension of freedom. He could do two things. He could recall the hunted animal when it was absent, and he could use this gift to make the animal’s presence familiar, so that somehow he exorcised the compulsions which otherwise dominated him in that presence. To my mind, the spear and the cave paintings are both created in the same temper: they are exercises in freeing man from the mechanical drives of nature.”

“In these words, I have put the central concept of my aesthetic. It goes back to the view that evolution has had, for man, the direction of liberty ….”[so] as Bronowski tells his audience, “….. it is not the thing done or made which is beautiful but the doing ….. Beauty is the by-product of interest and pleasure in the choice of action. (My emphasis). Every great movement in art has this stamp, that is a breaking through, a breaking out into liberty.” (Bronowski, 1955, pp47-48). I have presented Bronowski’s views here to an extended degree because they are his beliefs on aesthetics, before he moves to consider Architecture.

Bronowski reminds his audience and his readers that “….. what inspires the critics of an age is also the high inspirations of the reign of Elizabeth [I], the Restoration and the Romantic Revival ….. there are also the times of scientific discovery, of economic expansion, of conquest, and of new political thought.” (Bronowski, 1955, p48).
With the foregoing elaborate discussion of aesthetics, Bronowski is now ready to consider Architecture as such. Bronowski applies his concepts of rational aesthetics to artists, designers and scientists in the various breakthrough ages that he has previously listed. He is careful to point out by a consideration of the work of Leonardo da Vinci, who had to take account of the new (to his time) requirement of perspective, that there is a duality which gives tension and structure to his aesthetic: for if there were no duality, there would be no field for aesthetic judgement. On the one side is the movement of our evolution, away from compulsive action and toward a widening freedom: this is each man's wish to choose his own acts and thereby become a person. On the other side are the limitations of the visual which, ridge beyond ridge, reappear to constrain and in a sense to sustain us: the state of human thought at any time, the boundaries of what has been discovered, our contagious anxieties, the rigours of convention and of social institutions” (Bronowski, 1955, p56).

The interaction between individual choice and social limitations which Bronowski sets forth here seems to me to be another way of describing the social-solitary interaction in human specificity. We are confronted with being solitary, self oriented and tending to be social, ie, part of our society. This links with the deficiency-self actualizing interaction which characterizes Abraham Maslow's work on *The Farthest Reaches of Human Nature*. (Maslow, 1971).

To return to Bronowski, he moves on: “The pride of the best men is to probe for these limits by the adventure of their work. There are the pioneering minds who press forward in the new freedom and create those works which, in exploring them, discover (because they reach) the new frontiers.” (Bronowski, 1955, p51) As he indicates further on, this is not only Bronowski on Architecture, it is Bronowski expressed most comprehensively in Chapter 6 of the thesis on *The Ascent of Man*. But applied particularly to Architecture.
Instances of Architecture, selected by Bronowski:

*Figure 7.10 Bronowski specifies “Lincoln Cathedral is such a creation.”*

*Figure 7.11 The Circus in Bath*

*Figure 7.12 Crystal Palace. (Bronowski, 1955, p51).*
The photos of Lincoln Cathedral, the Circus and Crystal Palace are published on the web at http://www.lincolncathedral.com/ and similarly the Circus at Bath and Crystal Palace. This reference kindly supplied by Murdoch University Library, 2003).

Bronowski extends into literature, science and art listing various instances, eg Coleridge, Rutherford, Cezanne, “all stretch out and fill the freedom they themselves created to its limits”. (Bronowski, 1955, p51).

Bronowski now is ready to attend to Architecture. He says “I hope it is now becoming clear of itself (my emphasis) why I chose to present this theory of aesthetics in the context of architecture. For I know no other work of which is so profoundly a balance – no, a passion – of freedom and necessity. The task of the architect is to design a shelter, as the task of the locksmith is to fasten it, and both are contained by the materials which they can use ..... The buildings of the great designers arch out of their materials as spontaneously as a fountain.” (Bronowski, 1955, p51).

Rita Bronowski again shows herself to be sensitive to her husband Jacob’s writing since essay 4 on The Shape of Things links in quite naturally to the design ideas of the architect.

Bronowski now returns to the “revolutions in architecture. Gothic in France in the twelfth century begins at once with the rib-vault and the buttress and for three hundred years is a constant play in the freedom (and the limitations) which these engineering devices give. They are means which, as it were, open space vertically; when that no longer yielded anything new, the Renaissance suddenly abandoned it, and opened the space horizontally.” (Bronowski, 1955, p51).

This leads Bronowski to consider the second development in architecture. “A horizontal building (if I may describe architecture in my own way) [says Bronowski] is not held to a single line of sight, and therefore must guide our attention by its organization of detail. For me, this articulation of parts, this search for organic structure, runs through the Renaissance. It floods into Baroque and exhausts itself there, because it had reached the limits of what seventeenth century materials could sustain .....” (Bronowski, 1955, p52).
Before following Bronowski into the next phase of change, I would like to say how Bronowski’s use of “vertical” and “horizontal” may well derive from his topological mathematical interests during and after his Cambridge days. They were only twenty-two years prior to the time of his architectural lecture.

Bronowski asserts, “The next revolution begins at a new problem: domestic needs in the climate of Paris and further north. It comes to life in the work of Christopher Wren at Oxford and Cambridge; and of his colleague Robert Hooke in the rebuilding of London after the fire.”

After some further references to Wren and Hooke, Bronowski says, “I want to stop at Christopher Wren and Robert Hooke.” (Bronowski, 1955, p52).

The significance of Wren and Hooke was that “Neither was trained as an architect. Both were ..... professional scientists ..... they were not minor figures, in the age of greater scientific speculation [seventeenth century] before our own..... These two springing minds rebuilt London. Was their architecture original because they were scientists or in spite of it?” (My emphasis) (Bronowski, 1955, p53).

“This is the type of question which now troubles all serious artists. The easy answer is to give science a sort of kitchen-maid’s place in architecture. To let her supply the materials and techniques and begin the creative work only when the skeleton has been fixed by some handbook engineer armed with codes of practice.”(Bronowski, 1955, p53). Bronowski has set the theme of this lecture with this provocative assertion.

This assertion leads Bronowski to come to the judgmental concern: “Every building is an invention, no less and no more. It begins with a problem, which has nothing to do with the looks, the construction or the layout of the building: how should the activity which the building is to house be carried out?” (My emphasis) (Bronowski, 1955, p54).

Early in this lecture I mentioned the dreariness of various buildings as Bronowski saw them in Britain. As Bronowski says: “If the architect is not asked to help think this out, he will build what Britain is now full of: office blocks which are (I know no exception) meaningless rows of holes linked by tunnels, power stations and town halls which are indistinguishable; and vistas
of semidetached houses which (though they may be poured in concrete and assembled in panels) differ from their Victorian models only because it is now too dear to dig out a basement.” (Bronowski, 1966, p54).

It is the power of Bronowski’s perceptions of the “indistinguishable” building which I am sure, motivated him to lecture on architecture as science and art to architects. I must express my own thoughts and feelings here. So many domestic buildings on the hillside of the Darling Range in Gooseberry Hill, Kalamunda and Lesmurdie – all around me, face west into the direct summer or winter sun and so many houses have blinds on the verandas, reflecting the after thought and awareness of the owners and builders. When my house was designed and built in Gooseberry Hill over 50 years ago, I recall the architect we engaged to design the house, saying to my wife and I, “if you want your house to face west to the horizon, you get yourself another architect.” I am so glad we didn’t get another architect and our house faces northwest away from the afternoon and early evening sunlight!

Bronowski moves to a summary of his beliefs. He says, “Architecture is not decorations and it is not a jigsaw of technical tricks. A building is not a beautiful shell, nor is it a functional shell. A building is the coherent solution of a problem in living ….. the architect must fit himself for solving all parts of the work in his own person. His invention is only free when it arises out of his own scientific, as strongly as out of his artistic, imagination ….. We all hanker for beauty expressed as freedom of choice because freedom (this is the crux of my aesthetic) is an emotional need as real as the physical need for rest, comfort and gadgets.” (Bronowski, 1955, p55)

What comes to my memory now is the Salk Institute building, photo of which I put in Chapter 4. The Salk Institute to which Bronowski moved ten years after this lecture, ie, 1965, meant freedom to explore “human specificity” as he put it.

Architects listening to Bronowski in the audience or reading his lecture as a journal article, must surely have felt, and still do I would think, deeply satisfied at the potential of their profession, when he set forth his last paragraph: “In intellectual revelations of the past, architecture has been a point of fusion: the most sensitive point at which new ideas in science and a new
conception of the arts have aroused and influenced one another. Men have learned both, unconsciously, from the daily sight of great buildings. Today the architect bears the same responsibility for making science, as well as art, visible and familiar, and for having each influenced and entered into the other. Architecture remains the cross roads of new science and new art. If the architect is willing to make them one, by learning to live naturally in both, there will at last be fine modern buildings, and citizens wise enough to see that they survive.” (Bronowski, 1955, p56)

I can well understand why Rita Bronowski would have selected this subject, since she would empathize with her husband’s views, from her position as a sculptor.

7.8  Art as a Mode of Knowledge

Before presenting the contents of the six lectures in “Art as a Mode of Knowledge”, I would like to give a short account of the life of AW Mellon.

Andrew W Mellon (1855-1937) was the son of an Irish immigrant to America, Thomas Mellon. Both Thomas Mellon and his sons Andrew and Richard were men of entrepreneurial skills. Andrew became 49th Secretary of the Treasury, under President Harding, retained by Presidents Coolidge and Hoover, serving the three Presidents from 1921 to 1932. Andrew Mellon was active in his father’s banking business and then amassed a great fortune from oil, steel,
shipbuilding and construction. In 1937 he gave to the Nation his magnificent art collection, plus 10 million dollars, to build the National Gallery of Art in Washington, DC.

In 1900, Andrew Mellon married Nora McMullen in Hertford, England and they had two children. From 1932-33 he served as ambassador to Great Britain, and later he retired to his native city of Pittsburgh where he lived until his death in 1937.

Andrew Mellon’s portrait was painted by British artist Sir Oswald Hornby Joseph Birley (1880-1952). He posed Mellon “at work beside his desk in a traditional seated format ….”

The foregoing biographical notes were compiled from Department of the Treasury. The Learning Vault, and National Gallery of Art. Researched by Murdoch University Library.

Andrew Mellon’s son Paul (1907-1999) said: “The lectures bring to the people of this country, the best contemporary thought and scholarship relating to the Fine Arts.

7.8.1 The Power of Artifacts

Bronowski begins the first of the series of six lectures saying, “The arts have been described in many different ways, but it is not usual to think of them as either expressing or as transmitting human knowledge. Yet I propose to say in these lectures that the arts are a most important carrier of knowledge, and in particular, that we derive from them an insight into human experience, and through that into human values, which to my mind makes this one of the fundamental modes of human knowledge.” (My emphasis) (Bronowski, 1969, p59)

Bronowski further clarifies what he means by knowledge in the arts when he says, “Evidently whatever knowledge art carries is not a form of instruction in the sense in which the knowledge we gain from science is meant to instruct.” (Bronowski, 1969, p59).

Bronowski proceeds to explain what the word “science” means, and he uses Newton’s Law of inverse squares to explain the predictive features of science,
and its practical quality, “... Science has a very practical application ...”
(Bronowski, 1962, p59)

Bronowski further sets the aim of the six lectures by saying that all knowledge
is predictive and with the arts, “people will act within their value systems.”
(Bronowski, 1962, p60) Hence, knowledge from the arts is predictive.

Continuing to contrast knowledge in science with knowledge in the arts,
Bronowski says, “The knowledge that science carries, then, (as in Newton’s
Law of inverse squares) is always an explanation. The explanations change
with the rolling on of the centuries. We no longer think that the motion of the
planets is explained by Newton’s Laws, but by more delicate and sophisticated
laws which Einstein proposed more recently ... one may think of the great
discoveries in the ways of knowledge and explanation [in science] that were
made in the past as having the same status as pictures in a great gallery, which
no one would think of painting that way today and yet which are what Yeats
in “Sailing to Byzantium” called “monuments of unaging intellect. I shall
propose in the fullness of time a definition of knowledge which is different
...” (Bronowski, 1962, p61)

Bronowski tells his audience of his own interests. He characterizes himself “as
a professional scientist and an early amateur in the arts .... during my own
lifetime my interest had shifted towards more biological science and in
particular, to what makes human beings what they are. I call my subject by a
title which I have invented myself, namely human specificity ...... the
characterization of what makes human beings specific, with which I am most
concerned.” (Bronowski, 1962, p62)

Contrasting animal and human behaviour which I have related in earlier parts
of the thesis, Bronowski then tells his audience, “My accent then is on those
things which have got human beings where they are. And among those things
language, reasoning, imagination, and their expressions in science and in art
are cardinal ...... why is it that we as human beings naturally express
ourselves in creative discovery – creative discovery in the sense of science;
creative enlightenment in the sense of art?” (Bronowski, 1962, p63)
A central feature of Bronowski’s understanding of human specificity is “Through all cultures that we know, one thread runs continuously, and it is made up of two strands. That thread is the thread of science and of art ....... It cannot be an accident that there are no cultures devoted to science which have no art, and no culture devoted to the arts which have no science ....... there must be something deeply embedded in the human mind – specifically in the human imagination – which expresses itself naturally in any social culture both in science and art.”

“The characteristic feature of all human cultures is that they make artifacts and this is what we mean when we say that the human mind is creative. That is why I have called this first lecture The Power of Artifacts.” (Bronowski, 1962, p63)

Bronowski completes each lecture with a number of illustrations. In this lecture 7.8.1 are illustrations from which I have selected figure 1, “the marvellous stone cleaver or axe, a comparatively well made object of its kind.” (Bronowski, 1962, p66).

![Figure 7.14 Acheulian cleaver (flint hand axe) from the Somme Valley, Cagny, Route de Boves, France. Peabody Museum, Harvard University. Photographed by Hillel Burger.](image)

Bronowski describes the axe as “a comparatively well made object of its kind. It is about a hundred thousand years old .... I begin with it in order to show you vividly how an artifact reveals what it is the moment you look at it. And even the man of a hundred thousand years ago who picked it up must have realized at once when he held it in his hand that the cutting edge at the top of
the picture is for cleaving or cutting. But the whole structure shows how it was made – how you can make such an object for yourself if no one has shown you how. And these features – what is it for? And what is the blueprint for it? runs through all the objects I am going to discuss.

![Figure 7.15 The 1925 Model T Ford. Ford Motor Company.](image)

He says, “I could not resist this Model T Ford when I was looking for expressive artifacts. And if you are in any doubt about what I have said (the fact that you really know how to make it once you have looked at it) well, there it is, any teenager could build the whole thing from that picture.” (Bronowski, 1962, p67).

Although I am far from being a teenager, this picture of the Model T Ford captured me by its compact and orderly sense of purpose. There is a style about it which is acceptable to me, today, 2003. I am sure that the style is the “pioneer style” which Bronowski discussed in lecture 4 of The Visionary Eye series. The car illustrates the triangle of tools, materials and purpose in the lecture, The Shape of Things and can be regarded as a work of art, just so much as artifacts in science and art generally.

Bronowski rounds out the concluding thoughts to The Power of Artifacts by referring to what he said in the first chapter of Science and Human Values and elsewhere – that the work of art is not something that you can look at passively. It must move you to pose two different questions. One is: What is he trying to do? And the other is: Why did he do it that way?..... You can think of the first of those questions in the work of art [and surely science too] as
having to do with content and the second of these questions as having to do with the style. ….. these things are not separable, because unless the style means to you that that is how the content has to be put, you have not begun to recreate the work of art.” (Bronowski, 1962, p68)

Applied to the stone axe, Bronowski says, “It is a failure to look at the stone axe and say not only ‘I see what it is for’ but also ‘I see how it was done.’ ….. No work gives you more than a journalistic summary of itself until you have also recreated it from the question, “Yes, I see what he was trying to do, but why did he try to do it that way?” (Bronowski, 1962, p69)

It is clear that what Bronowski is emphasizing is that the person regarding the activity in art or science must ask and give himself/herself an answer, which can be achieved by studying style and content.

Bronowski calls on William Blake, whose work has been considered in chapter 3 of the thesis. Referring to Blake’s poem, The Tyger from Songs of Experience, Blake asks of the artist God, “How did He come to make the tyger” and “why did he make it” and Blake asks of God “Did he (God) smile his work to see? Did he who made the lamb make thee?” Asking style and content of God.

Bronowski ends his lecture with, “to recapitulate this central question: What is the artifact, what is the work of art saying? And why has it been made in that way?”

\[
\text{Did he (God) smile his work to see?} \\
\text{Did he who made the lamb make thee?}
\]

(Bronowski, 1962, pp 69-70).

7.8.2  The Speaking Eye, The Visionary Ear

Despite what he describes as “that rather outrageous title”, Bronowski connects lecture 2 to lecture 1 of these Mellon series, by saying, “all human activity – scientific and artistic is the product of an artifact.” He proceeds to say, “as soon as you see them, two things are apparent to you ….. what it is for and how it is made.” (Bronowski, 1962, p75). What it is for and how it is made as a poem, a painting, a sculpture, relates to the title of this lecture, Bronowski chose in order to draw attention to the fact that “the eye and the ear
are intimately connected in all works of art.” (Bronowski, 1962, p75) Bronowski further explains that “It is not true that only the eye sees and the ear hears or only the mouth speaks. On the contrary, my title in intended to draw attention to the unity of the imagination as it is expressed both in the visual arts and in poetry.” (Bronowski, 1962, p75)

When Bronowski makes this statement he fulfills his obligation to the paintings of the Mellon collection in the National Gallery of Arts, but as well makes sure that his own attachment to poetry is maintained. And now comes a central word in this lecture – image. Bronowski fixes this word as he tells his audience of listeners or readers, “..... my title is intended to draw attention to the unity of the imagination as it is expressed both in the visual arts and in poetry.” (Bronowski, 1962, p75) He makes his belief quite firm when he rounds out his introduction to this lecture by saying: “I want to say quite positively that literature in general and poetry in particular are not simply made of words but operate with images quite as characteristically as does painting.” (Bronowski, 1962, p75)

I do not think that the title of this lecture/essay is as “outrageous” as Bronowski says, because the eye, ear and mouth all interact to cooperate in using images to present knowledge.

To illustrate how the interaction occurs, TS Eliot, a modern day poet, and Alexander Pope and Augustan pre-Romantic poets are referred to. I will record Bronowski’s example in the following stanza:

*The chair she sat in like a burnished throne
Glowed on the marble, where the glass
Held up by standards wrought with fruited vines
From which a golden Cupidon peeped out
(Another hid his eye behind his wing)
Doubled the flames of seven branched candelabra
Reflecting light upon the table as
The glitter of her jewels rose to meet it,
From satin cases poured in rich profusion.*

(Bronowski, 1962, pp75-76 from TS Eliot The Waste Land, A Game of Chess)
Bronowski says he "chose this passage because the visual quality in it is very clear ...." What Eliot in doing is rewriting the following kind of passage from Alexander Pope's, *The Rape of the Lock*.

Unnumbered treasures ope at once, and here  
The various off rings of the world appear  
From each she nicely culls with curious toil  
And locks the Goddess with the Glitt'ring spoil.

The poem is about "a girl at a toilet table ... (the girl is being looked after by her maid)." (Bronowski, 1962, p76).

Bronowski points out as the poem goes on that Pope's lines are highly colourful, by the description of her jewellery on her toilet table. Bronowski gives other examples of highly coloured poetry including the description of Cleopatra in Shakespeare's 'Anthony and Cleopatra', where Shakespeare says the description of Cleopatra on her barge is so rich that "It beggared all description."

The phrase "beggared all description" is well known amongst people generally and Bronowski says the image in this phrase is in the work "beggar," and he relates it to William Blake's *The Beggar's Rags*, fluttering in the Air." So the word "beggar" has a deeper significance than describing what Cleopatra or the beggar looked like.

Bronowski calls on a poem, *Morning Walk* by DH Lawrence, about a gang of labourers on a railway siding, to further illustrate "that poetry is written not just in words or even visually, not just in colours and not just in descriptions, but in images. It is therefore timely to ask something about the image in the human mind. And I shall begin with a brief description of the human imagination." (Bronowski, 1969, pp78-79).

Although previous chapters of the thesis, especially chapter five have already discussed the "image in the mind", I will still present Bronowski's work in this lecture 2 of *Art as a Mode of Knowledge*. He says "I use the word "imagination" to mean quite simply the manipulation by a human being of images inside his head ..... People who see the images very vividly often have it in an even stronger form." (Bronowski, 1969, pp79-80)
Bronowski describes how William Blake “saw angels, how in his old age he drew people who were not in the room …… This is a curious psychological gift; children have it quite often but most people lose it in adult life, and it is called eidetic imagery. And people who have eidetic imagery tend to see the image as if it were outside their head ……” (Bronowski, 1969, p80)

Bronowski goes on to describe experimental studies done by Walter Hunter, an American psychologist, in the early part of the twentieth century. Hunter did studies using dogs and then children – with both dogs and young children they were rewarded; with food in the case of the animal and memory control and achievements in the case of children. The animal was set before three doors with a light on one door and if the animal learns to run to the door with the light over it, it is opened and he is rewarded. Hunter then held the animal for a short time, turned off the light and after a short time – ten seconds, “very few animals were able to remember when the light went on ……” (Bronowski, 1969, p81) “With some children aged two, three and four years old,” as Bronowski describes Hunter’s further studies, “He would turn on the light over one of the other doors and then he would engage them in conversation. And one little girl said to him at the end of about half an hour, “You know, if you do not stop chattering I shall forget where the light was”. (Bronowski, 1969, p81) Hunter having turned the light off earlier.

Bronowski characterizes the child’s remarks compared with the animals’ responses as “spectacular”, but the child’s remarks to me are charming and delightful and give colour to Bronowski’s work. And it is more than charming and delightful. It illustrates that, “The gift of human imagination, then, is the ability to recall the past that it has a visual or symbolic impact. It is with this ability that the imagination works.” (Bronowski, 1969, p82)

Bronowski gives another example of how humans can invent and manipulate situations …… interior manipulation of images on which human foresight depends and which begins in the hindsight which is the human form of memory …… “The images that we use most of the time – the symbolic units we use – are words.” (Bronowski, 1969, p82)

After reviewing the rise of the power of human memory during the Renaissance, Bronowski comes to a statement which is essentially him and
has been set forward in earlier work in the thesis, such as the studies of poetry. He says, "The gift of imagination is the twofold movement by which it both manipulates images in my head and sets them spinning with a kind of communicative force which recreates them in yours, whether I am looking at a work of art, reading a poem, or talking about a theorem." (Bronowski, 1969, p83)

Bronowski moves to the conclusion of this lecture or essay by observing that "All human speech is a mystery, but it is certain that it is joined in the evolution of the human brain to development of the visual areas ..... And the visual centres (the visual cortex) lie close to the aural centres."

It does not seem so "outrageous", as Bronowski said at the beginning of this lecture/essay, to link the eye with speaking or the ear with seeing.

So is his practice in the Mellon lectures, Bronowski concludes with a series of pictures; "some of the images that have exercised great symbolic power, in poetry and art, and to make the point that these are, to my mind, indissolubly joined." (Bronowski, 1969, p84)

As with lecture 1, I have selected two pictures. The first picture is what Bronowski calls "the marvellous sphinx to remind you that the juxtaposition of man and animals is also part of literature – in this case, part of the Oedipus legend – and says something about how we think of ourselves as animal and man together which occurs both in the visual and in the spoken symbol." (Bronowski, 1969, p82)

I do agree with Bronowski – the sphinx has all the power of Oedipus.

For the second work, I selected a painting of Paul Gauguin, which to me is so delicate and such contrast to the power of the sphinx. Bronowski says "All the Paul Gauguin paintings have a tremendous poetic literary quality. I chose Fatata te Miti" because it is not only a glorious painting but also a highly literary work ..... they ..... carry a highly emblematic quality for us ..... the imagery of an earthly paradise." (Bronowski, 1969, p85)
Bronowski finishes lecture 2, with “Sight and sound, image and word, are thus essentially wedded in a kind of emblematic symbol.” (Bronowski, 1969, p87).
7.8.3  **Music, Metaphor and Meaning**

Bronowski opens this lecture saying, “I come now to the crucial subject in any deep understanding of the arts: the relation of style to content ….. Having a style is essentially a human thing ….. it is very specific to human beings that they have the ability to do things in a highly individual way.” (Bronowski, 1969, p93)

I have found this lecture complex and difficult to understand. It does not have the flow of words so characteristic of Bronowski, and as I understand it, the title *Music, Metaphor and Meaning* means **Style and Content, Imagery and Meaning**. (My emphasis)

Bronowski asks of his audience, “Let us concentrate for the moment on poetry”, and he takes the work of the poet AE Housman and his lecture *The Name and Nature of Poetry* which Bronowski heard when he was an undergraduate. Housman quoted a passage from *The Book of Common Prayer*,

“‘But no man may deliver his brother, nor make agreement unto God for him.’ That is to me poetry so moving that I can hardly keep my voice steady in reading it. And that is the effect of language I can ascertain by experiment: the same thought in the Bible Version. “None of them can by any means redeem his brother, nor give to God ransom for him,” I can read without emotion.” (Housman in Bronowski, 1969, p94)

Housman discusses a line from John Milton, “*Nymphs and Shepherds, Dance No More*”, and concludes “Poetry indeed seems to me to be more physical than intellectual.” (Housman in Bronowski, 1969, p95)

Bronowski follows Housman’s reactions of “precipitation of water to the eyes”, meaning tears by discussing the poetry of Thomas Campion who wrote in the Elizabethan age. Bronowski takes four lines particularly;

*Lost in our freedoms,*

*When we submit to women so:*

*Why doe wee neede them,*

*When in their best they worke our woe?*

(Campion in Bronowski, 1969, p97)
And Bronowski observes Campion’s poem (not titled): “The music has a very strong structure, and we are suddenly reminded that of course, the central element of music is exactly the structure element” (Bronowski, 1969, p97)

The reference to music and structure is how I understand the title of this lecture and to which I refer at the beginning: “music, metaphor and meaning” means style, content, imagery and meaning.

Bronowski now turns to a prosodist, “the great Russian prosodist and linguist, Roman Jakobson, to analyze the music of William Blake’s poem Infant Sorrow which I have referred to earlier in the thesis. The eight line poem, “Infant Sorrow” is from Songs of Experience, (1794). Jakobson’s analysis of the poem is long and I found, and I suspect Bronowski did too, tedious. [Prosody is the science and study of poetic metres and versification.]

Bronowski concludes from Jakobson’s analysis: “Now Jakobson talking about how the poet chooses the words and I talking about how he chooses the images come out with something which I hope conveys the sense that style and the content have to be a unity of this kind. You will recall that my second lecture was much concerned with the notion of putting together the visual image and the word to make a symbol, an emblem which contains within itself the complete expression of some likeness by which the poet or the painter attempts to make you experience an inwardness in the world which there is no way of communicating to you unless he makes you re-experience it. This Blake poem (Infant Sorrow) makes it clear that the metaphor works at three different levels; universal metaphors; the metaphorical system of the poet and the special range of metaphors used in a particular poem.” (Bronowski, 1969, p101)

The poem that Bronowski refers to is,

\begin{verbatim}
 My mother groaned! my father wept
 Into the dangerous world I leapt.
 Helpless, naked piping loud:
 Like a fiend hid in a cloud.
 Struggling in my father's hands,
 Striving against my swaddling bands.
\end{verbatim}
Bound and weary I thought best
To suck upon my mother’s breast.

(Blake in Bronowski, 1969, p98)

Bronowski continues: “When you think of words like “My mother’s breast”, “My father’s hands” you are conscious that Blake is appealing to metaphors which are universal. We all understand that. We know perfectly well that when the metaphor has these peculiar human qualities, then it is one we would recognise in any situation in any poetry, in any country. Then there is a second level of metaphor which is very peculiar to the poet. In Blake this is very strong ….. “The Beggar’s Rags, fluttering in the air” ….. could not have been written by anybody but Blake. And it is because that kind of symbolism also has a strong, social punch, inherent in the way Blake wrote poetry. Every poet has a set of images, a kind of metaphorical world which he inhabits, which is not shared by the rest of the human race ….. this compounding of the word and the visual image makes a unit which we recognise as a means of direct access to communication with us.” (Bronowski, 1969, pp101-102)

Bronowski comes up to date as he has just done and looks ahead when he goes on to say, “….. there are three levels at which literature speaks. There are three universal metaphors which all human beings share and which we recognise at once (mother, father, hand, breast, mountain, sea) – all the things of which the popular songs are made. And then there are the ones which are characteristics of the poet, such as Shakespeare’s ability to say, “Daffodils that come before the Swallow dares.” But then there is the third level on which I shall concentrate in my next lecture, and that is the imagery which is peculiar to that poem, like the things that a painter paints in that picture, and not in all the other pictures.” (Bronowski, 1969, p102)

Bronowski considers the plays of Shakespeare in the same manner as the poet or the painter and he says “….. the style of the work of art, and of the whole output of an artist is intimately related to the content.. Style has many components which together make up this relationship, but I propose to concentrate on the element of imagery.” (Bronowski, 1969, p104)

Bronowski offers a series of examples and as with the previous lectures I have chosen two examples:
I selected the Sumerian ideogram of 3000BC because it aroused my imagination. Bronowski writes: “Notice the strongly visual element, even though this is just a piece of writing. The people who made ideograms were on their way to the alphabet in whom our poems are now written. And the way to that alphabet lay exactly in the way they looked at nature.” (Bronowski, 1969, p104)

And I had to select William Blake’s illustrated poem *The Tyger* even though it is poorly printed in Blake’s own publication.

Bronowski points out the anti-authoritarian note in *Infant Sorrow*, “here it is in *The Tyger* in which he just asks exactly these questions [mother, father, swaddling bands] because he would have liked to be both a lamb [infant] and a tiger. And so would we all; I mean that is what the human dilemma is all about.” (Bronowski, 1969, p106)
Figure 7.19 “The Tyger”, from “Songs of Experience” (London, 1794) by William Blake.

Bronowski points out, as I discussed in chapter 3 of the thesis, that “Blake was the first English poet to which the Industrial Revolution was real and the lamb and the tiger issue came forth in Blake’s lines:

When the stars threw down their spears,
And water’d heaven with their tears.
Did he smile his work to see?
Did he who made the lamb make thee?
Tyger! Tyger! burning bright
In the forest of the night,
What immortal hand or eye
Dare frame thy perfect symmetry?

(Blake in Bronowski, 1969, p107)
And so says Bronowski, “When the stars threw down their spears. And water’d heaven with their tears”, is the right way of saying that God is full of pity – he wants to make the lamb, but in the end the instrument has to be the tiger? And it is the essence of poetry, of painting, as of all art, to communicate that the leap over the gulf between us – to make the metaphor suddenly speak to us, not so that we understand it, but so that we recreate it. Style is the means by which we recreate the content for ourselves.” (Bronowski, 1969, p108)

7.8.4 The Act of Recognition

Bearing in mind that these lectures are for the AW Mellon series of six, it is not surprising to me to realise that, The Act of Recognition, is very similar in theme and content to Lecture 2 The Imaginative Mind in Art which Rita Bronowski chose in The Visionary Eye series.

When Bronowski talks or writes about The Act of Recognition he means, especially in poetry, that to recognise what a poet writes, the reader or listener must recreate within himself the poet and his poetry. In other words the act of recognition is the art of imaginative interrelationship between poet and reader.

Having my own response to the lecture title, I will quote Bronowski’s beginning when he says, “In this lecture I want to analyse the crucial difference between the way in which an ordinary statement or representation speaks and the way in which a work of art speaks to us. As usual, I shall concentrate on poems, but what I have to say is, I believe, applicable quite generally to musical, visual and literary works.” (Bronowski, 1969, p114)

Bronowski gives a reference to a book Literature and Science, written by Aldous Huxley towards the end of his life. Huxley proposed “the literary statement, the poem is always highly particular, whereas the scientific statement is always very general. Now in some sense what Huxley says is very true, nor was he the first person to point this out.” (Bronowski, 1969, p114)

Bronowski says he quoted Newton’s law of inverse squares, “….. it is certainly true that this is a highly general statement. It applies to all bodies, it does not discuss their colour, their history, what they mean to you, why they frighten you or interest you …..” (Bronowski, 1969, p114). He goes on, “Now if we compare this to some short, succinct statement by a poet, we see at once
how much more particular the poet’s statement is. I have quoted before a
couplet of Blake’s

_The Beggar’s Rags, fluttering in the Air_  
_Does to Rags the Heaven’s Tear_  

(Bronowski, 1966, p114)

Bronowski then takes the first six couplets from Blake’s _Auguries of Innocence_, [I will take only the _Robin Red Breast_ since the couplets have been
discussed before]

_A Robin Red Breast in a Cage_  
_Puts all Heaven in a Rage_  

And he says these couplets of this kind are “highly specific” [and they] “work
for you” [because] “as Housman said in the passage I quoted in my last lecture
— that here poetry is not the thing said, but the way of saying it ….. the content
presumably is that to cage a living creature is a fundamental outrage against
nature. That is something Blake said over and over again all his life.”

(Bronowski 1966, p115)

Bronowski is at pains to point out that the couplets about the robin red breast,
dogs starved, and beggar’s rags are, “….. What the verse says is in fact a
highly general statement, quite as general in any sense as Newton’s statement
about the attraction between two masses. It describes something which we feel
to be a social criticism ….. The fact is that powerful human statements (which
have a wide meaning for many people), whether they are in prose or verse,
whether they are in painting, or music, or whether they are in the form of
political exhortations or of scientific statement, all such statements have a
wide degree of generality. So whatever the message of the poem is, it is
certainly a very general message.” (Bronowski, 1966, p116)

Bronowski is very effective in his arguments here to demonstrate that the
distinction between science and literature was not as simple and distinctive as
Aldous Huxley asserted, and which he made in his work, _Literature and Scienc_”, referred to earlier in this lecture. There is both general and particular
in the work of art, and this leads Bronowski to say: “So the real question we
have to ask about the work of art is, how in the world does it speak so
powerfully to us using the particular to carry a general message? I am going to say this occurs because of a special way in which the human mind works. Namely, we not only speak in language but also think in language and the poet in some way by using the particular enters not only into our public communication but our public thought.” (Bronowski, 1966, p117)

Bronowski chooses the poet Dylan Thomas, and a “straightforward poem with a very simple message and analysing it.” (Bronowski, 1966, p117)

Bronowski chose Dylan Thomas in his lecture The Imaginative Mind in Art (1964), which occurs earlier in the series The Visionary Eye in chapter seven. Nevertheless I will present Bronowski’s thoughts on Dylan Thomas again since they occur in the Mellon 1966 series.

I will reproduce the first verse as I did in The Imaginative Mind in Art Dylan Thomas writes:

\[
\text{The force that through the green fuse drives the flower} \\
\text{Drives my green age: that blasts the roots of trees} \\
\text{Is my destroyer.} \\
\text{And I am dumb to tell the crooked rose} \\
\text{My youth is bent by the same wintry fever.} \\
\]  

(Dylan Thomas in Bronowski, 1966, p117)

Bronowski comments: “As in so many of Dylan Thomas’ beautiful poems the central theme here is very simple and consists in verse of the confrontation of the two same ideas … ‘the force that through the green fuse drives the flower Drives my green age.’ The contrast of “green” and “age”, this contrast of two opposing words, occurs repeatedly in the poem.

Bronowski contrasts Dylan Thomas to one of the elegies of Rainer Maria Rilke and then returns to consider Dylan Thomas further, so although Bronowski does refer to Rilke on occasions I will not be concerned with Rilke but continue with Bronowski’s consideration of Dylan Thomas, for I do agree with Bronowski, Dylan Thomas gives a powerful commentary on the human personality.

Taking verse 2 of Thomas:

\[
\text{The force that drives the water through the rocks} \\
\]
Bronowski points out that “the image is of the surge of water and the water drying up in the desert of the long hot summer.” (Bronowski, 1966, p119)

Thomas continues on the five verses presenting the same ideas in contrast, and as Bronowski points out “.... in some way this enormous elaboration of metaphors finds a word, an image, a simile which is yours, and in terms of which the poem somehow enters into your mind and unfolds into it.” (Bronowski, 1966, p126)

Whether it is Thomas’ ‘green age’, or Blake’s ‘dog’ or ‘robin red breast’, Bronowski says the metaphor “somehow enters into us,” and from that moment we shape the poem, we recreate the poem, because there is a moment in which it speaks our inner language. There is a distinction between the outer public language that we all use and the inner language which we human beings work with in our heads all the time, the language of our own imagination. And it is to that language that these poetic statements appeal.” (Bronowski, 1966, p120)

Bronowski goes on to quote a poem of WB Yeats, *Why Should Not Old Men Be Mad* but it is a lengthy poem which I will not reproduce. In the end what Bronowski emphasizes is that Thomas does not deal with whether you are young or old but “when you are young growing older is wonderful and when you are old growing older is dreadful.” (Bronowski, 1966, p121)

To me as I write out Bronowski’s meaning in this lecture, this understanding of Dylan Thomas strikes me with great force, as I think back to my own early years and forward to my present age and experiences. Whether it is the plants in my own garden growing when they are recently planted or pushing against the garden wall later on, as I have described earlier, or whether it is myself as a person, Bronowski shows me what the act of recognition means. In this way he is successful in this lecture 4 of the Mellon series. And it is not that I am a very special person. I am affected by Dylan Thomas and by Bronowski’s discussion because, as Bronowski points out, “Every human personality is unique, but it is unique because it contains within itself a special arrangement of all those things that we all share.” (Bronowski, 1966, p122)
Bronowski summarizes this lecture 4 to the present point by saying there is "the particular metaphor [which] is what drags it (the universality of the human situation) through your mind, into your mind, and so into a picture of all humanity. Let me now turn to a few illustrations which I hope give the same sense in pictures." (Bronowski, 1966, p123)

As usual in each of the lectures in *The Visionary Eye* Bronowski presents six visual illustrations. I have selected two of them:

*Figure 7.20 “Rue des Moulins” (1894), Henri de Toulouse-Lautrec. Chester Dale Collection, National Gallery of Art, Washington, DC*

*Figure 7.21 “A Tilbury Shelter Scene 1940-41”, Henry Moore. The Tate Gallery, London.*
“Toulouse-Lautrec’s work Rue des Moulins shows what I suppose was a fairly ordinary scene in a brothel in Paris just less that a hundred years ago. The girls are so charming - just look at the smile on the face of the redhead .... The smile on that girl’s face is not something outrageous, it is something with which we very well understand our own sympathy.” (Bronowski, 1966, p123)

Yes, it is just the smile on the girl’s face and the look of self acceptance on both girls that I could recognise as human, just as human as any situation and it is the smile and self acceptance which caught me and influenced me to want to select this painting.

The second painting I selected is A Tilbury Shelter Scene, by the famed sculptor of his day (earlier in the twentieth century), Henry Moore. This is such a contrast to the two girls in the brothel – crowds of people in World War Two who spent the night sheltering from the Nazi bombing raids on London in the underground tube. As Bronowski said “..... they [the people] seemed to exist in a state of suspended animation, as if they had been frozen for a time.” (Bronowski, 1966, p124)

Yet despite the seeming lack of life in the crowd of people waiting for the night to pass, I could recognise by their postures they were still humans, simply waiting.

Both pictures allow me the act of recognition. Bronowski concludes that “..... art communicates extremely general statements in a similar way that the person who made them speaks and you who hear them recreate them for yourself.” (Bronowski, 1966, p126)

There is no doubt that Bronowski’s presentation is convincing for me – Dylan Thomas’ “green age” in the poem, the girls and the crowd of people in the two pictures arouse personal imagery in me of my life because I can relate to the poetry and the pictures.

7.8.5 Imagination as Plan and as Experiment

When I first read the title of this lecture I was confused by the expression “As Plan and As Experiment.” I thought experiment would be part of a plan as would be expected in science.
Bronowski’s introductory paragraph is pertinent. He says “When I began these lectures, I drew attention to my choice of title *Art as a Mode of Knowledge* because, I said it is unusual to think of art either as expressing or communicating knowledge. Through the lectures since then, I have built up the sequence of artifact, word and image and finally the notion, that in the work of art the image has the special quality of trying to direct from the artist to you an immediacy which other generalizations lack. It was specifically the point of my last lecture that it is *not* true that the statements implied in works of art are any less general than those implied, say in, science. And yet it is clear that the work of art has a quite unique capacity which somehow makes it resound in you as if it were your private property.” (Bronowski, 1966, p133)

Bronowski draws upon Blake’s *Robin Red Breast* couplet to demonstrate its generalization and his individual person’s response and he compares this with Newton’s Law of inverse squares, but since this comparison has been made and discussed before in the thesis, I will not repeat it.

Rather, I will proceed with Bronowski’s explanation of this area, in particular. He says, “I have called this lecture *Imagination as Plan and as Experiment*. The contrast I shall develop has to do exactly with this point. How do we imaginatively enter the experience of other people, including both the experience about which the artist writes or paints (the content), and the experience that the work of art expresses (the style) ….. the crucial nub of the work of art: its ability to communicate to us something which we instantly recognise as an echo of our own experience and in which we see unfold a sense of universal human experience.” (Bronowski, 1966, pp133-4)

Bronowski emphasises the universality of human experience by referring to a passage in John Donne’s [1572-1631] later sermons which says “No man is an Island, entire of itself” and Bronowski interprets this to mean each man is an island in the total archipelago of human nature. ….. everybody is rather like you although you are essentially individual. It is the echo in yourself of everything about human beings which makes the work of art impressive and indeed enormously exciting to you. And I call it a work of knowledge …..” (Bronowski, 1966, p134)
Bronowski’s interpretation of John Donne and his relation to archipelago and art brings to mind the last weeks of my dear wife Elizabeth’s terminal illness, when despite her distress, she was still Elizabeth and I could recognise her as human, as a mode of knowledge.

Bronowski reinforces his phrase “mode of knowledge” as the activity of art by a discussion of the poetry of Gertrude Stein, Dylan Thomas and the marvel of Charles Dickens’ *Oliver Twist*. Bronowski concludes from the consideration of Stein, Thomas and Dickens that “..... the real crux of life which one learns as one grows older is that there are no solvable problems. And that is the great lesson with which you have to be satisfied. That it is not *solving* the problem which is what life is about, but *living* the problem .....” (Bronowski, 1966, p137)

And remember, when he writes about Stein, Thomas, Dickens and John Donne, I feel that Bronowski himself was a man of courage growing from his Jewish childhood with his ‘Old Testament’ father in Poland to his company with “civilized minds” in England to his shock at the extent of the destruction of Nagasaki and to his move to the Salk Institute in the US to study “human specificity.” I have put the developmental aspects of Bronowski in inverted comas to indicate the vital phases in his life.

Bronowski further considers John Donne’s line *No man is an island* by pointing out that “censorship is pointless.” (Bronowski, 1966, p138) The basis of this view, is that as I have mentioned earlier, that we live our problems, rather than solve them. We all live the poetry of Stein and Thomas and are responsive to the works of Charles Dickens. The novel *Oliver Twist* includes the undesirables Fagin and his child thieves, the Artful Dodger and Bill Sikes who murders Nancy. Sikes in trying to escape the Nancy situation, across the roof of houses, catches himself on a rope and hangs himself.

Stein, Thomas and Dickens range from Eros to Thanatos, using Freud’s expressions. We are all good and all bad.

Bronowski illustrates his point of view by drawing upon his own work, *The Face of Violence*. I gave extensive discussion of this play, written in 1950, in
chapter 5 of this thesis, but I will repeat some aspects of Bronowski’s consideration in this lecture 5.

Bronowski repeats the concluding dialogue between the heavenly twins, Castor and Pollux, as they discuss the journey of Mark from a small waterside village to satisfy an obsession of revenge.

The twin Pollux says:

\begin{quote}
No, The man [Mark] made a voyage, 
And the end of the voyage was discovery. 
He went out to explore 
The jungle within the heart 
And the continent under the dark mind. 
What else was there to find? 
What else is there to show at the end of a voyage of exploration 
But a scar and a scribbled chart?
\end{quote}

Bronowski states that the dialogue between the two heavenly twins, built about the account given by Pollux, states “that we only go wrong when we try in our lives to live the extravagance directly. Yet it is that which moves us most deeply in literature and art because we recognize a part of ourselves which will never be expressed at other times. \textbf{And this is the sense of kinship with humanity as a whole which art communicates.”} [My emphasis] (Bronowski, 1966, p130)

Bronowski says, “So we see that these if considered a mode of knowledge because of the kinship which the work of art communicates ..... it is knowledge of what it is like to be this kind of man and every kind of man. In the end what the book and the painting is about is to present to you essentially conflicts of conscience.” (Bronowski, 1966, p140)

Bronowski defines, “conscience means to feel, to know with – it is knowledge with another person ..... Conscience is a form of knowledge which you get because you become aware of what it is like to be that particular person.” (Bronowski, 1966, p141)

Bronowski turns to drama. He says, “Drama shows this so much better than other forms of literature that I would like to give you an example. What is
OTHELLO about? …. The point of the play is that a man [Othello is a black general in Venice] who has other reasons to think that his wife may not have the devotion to him that he hopes, is given to jealousy. What kind of jealousy? Someone steals a handkerchief from her and look at all the fuss he makes about it…… the point about jealousy is, it always fastens on what are highly symbolic situations; gifts which have no value at all. ..... she (Desdemona) did not lose anything which was worth anything at all. She lost a highly symbolic gauge. It was stolen from her and the man who stole it, that mephistophelian character, is just a kind of god or devil in this, who knows that it is with trivial symbols that you enter and operate on the human mind.” (Bronowski, 1966, p142)

Bronowski proceeds to “two concluding points. First of all, it should now be clear why I talk about Imagination as Plan and as Experiment. Imagination as plan is important. Science, statistics in general, solving problems, is an important imaginative activity, but it is not the imaginative activity of the arts, because that is constantly experimenting with situations like that. You can be quite sure that when Shakespeare started the play [Othello] he did not know how it was going to finish ..... I know this because I know that it happened to me when I wrote “The Face of Violence”. It seemed to me so clear what I was going to say, but what in fact I said was in some mysterious way determined by the characters.”

“Now this sense that every work of art is an experiment in living is what I want to convey to you, coupled with the fact that reading the work of art is your experiment in living it. And I mean that. Nobody’s reading of Othello is the same as mine. Nobody is moved by the same parts.” (Bronowski, 1966, p143)

Bronowski refers to Dylan Thomas as another example, but I will not record that because he has discussed Thomas on a number of previous occasions. He goes on to say, “You recreate the work of art when you see it, when you hear it, when you read it, because you enter into it.” And Bronowski reiterates, “….. the style is as experimental as the message.” (Bronowski, 1966, p143)

And as to the individuality which is so important to Bronowski, he says, “….. ever since the Renaissance, the Western world has operated on the belief that
human beings are highly individual and that the exciting thing about being a
human being is matching your individuality with how other people are.
[My emphasis] That is what the experimental style displays. The most striking
way in which it displays it is actually in self portrait.” (Bronowski, 1966,
p144)

I have emphasized the line, “matching your individuality with how other
people are”, because it seems to have the solitary – social aspect of us all, a
basic human specificity quality we all have. I would say we are constantly
having to experiment with our living, having to live in a society of people.
Bronowski says, “you have to have a sense of the direction of your own
experiments: this is the way I want my life to be, this is my kind of
conscience” and we get “an ethic a set of values.” (Bronowski, 1966, p144)

Anticipating, Bronowski says, “And that is why my last lecture will be called,
The Play of Values in the Work of Art.” (Bronowski, 1966, p144)

As is usual in the Mellon lectures, Bronowski selects six pictures, and of these
six I have selected two paintings of painters who did their self portraits,
Rembrandt and Van Gogh.

Figure 7.22 Self Portrait, Rembrandt van Rijn. Widener Collection, National Gallery of Art,
Washington, DC.
Bronowski comments: “Rembrandt painted himself very often. I think he liked doing it, as also, in the later part of his life, he could not sell his pictures because nobody wanted him to paint portraits. So he thought he might just as well paint himself. Rembrandt had a very remarkable personality. He painted this just at the stage of his life when the young debonair cavalier had passed and the rather heavy, confident old man is to come. It is a portrait of a questioning burgeoning, powerful man in middle life. And now look at Van Gogh’s self portrait

![Self Portrait, Vincent van Gogh. Chester Dale Collection, National Gallery of Art, Washington, DC. (No date)](image)

The painting captures the expression of a restless, highly experimental character. (Bronowski, 1966, p145) It is the contrast between these two men that led me to select them of the six available. Two Dutch painters separate in centuries of time, using their imagination to experiment with self expression.

Bronowski goes on to consider the portraits of three women, a girl in early life, a middle aged lady and a woman who considers her life has gone by. As with the two men, Rembrandt and Van Gogh, so with the three ladies, but in more detail, Bronowski discusses the imagination in the works.
And Bronowski concludes lecture 5 by saying, “in the end a great portrait makes one aware that every set of actions is also a way of life, a set of values. And that the work of art exhibits the play of those values.” (Bronowski, 1966, p147)

7.8.6 The Play of Values in the Work of Art

Because of the complexity and variety of ideas which Bronowski gives to this, the final lecture in the Mellon Series, I read the lecture several times.

Bronowski presents the idea of the “balance of values” (1966, p163) as a central concept, but he begins the lecture with the assertion: “The work of art is not a slice of life. No school of realism produces replicas of some visible part of reality and simply says “This is what reality looks like.” No portrait painter who has anything important to say says only that. And if you think back to the portraits of Rembrandt and Van Gogh, it will come to your mind at once that they say something else about the sitter and about the painter, particularly when they happen to be the same person, than merely, “This is what he looks like.”

“Thus no work of art is simply a presentation of reality as such. At the other extreme, no work of art is simply an abstract pattern, either of paint or of music or of words ....”

Every so often people say, “The best work of art is simply realistic” and then every so often people say, “The best work of art is simply abstract.” (Bronowski, 1966, p153)

Bronowski summarizes this extensive introduction to lecture 6.6, from which I have selected some ideas, when he says “...... the work of art is in some sense an experiment in living that we share with the artist. And that has two aspects to it. First of all, we share with the artist ...... I have been insistent throughout that the work does not exist on the canvas, in the book until you breathe life into it. The artist creates the work, the spectator recreates it.” (Bronowski, 1966, p154)
Bronowski continues this theme saying, “...... every time you look more closely at the work and in a more informed way, it suddenly comes to life for you with more animation and greater depth.” (Bronowski, 1966, p154).

Bronowski recalls the emphasis given to Dylan Thomas’s, “The force that through the green fuse drives the flower,” and to Blake’s, The Tyger ...... that is one side of the art of recreation – simply getting more out of what the poem or the portrait says by knowing more about it.” (Bronowski, 1966, p154)

I agree with Bronowski’s reference to Dylan Thomas’ “force” from my own experiences of the jade in my garden. It grew in size and in so doing forced some rocks in the garden wall to move out of line.

Bronowski now turns to what he describes as “...... the other side of course, is much more important, and goes much deeper. And that is unless you are willing in some sense to share the experience of the artist you never really get the deep pleasure that the poem can give.” (Bronowski, 1966, p154)

Bronowski turns to TS Eliot American born, British poet; TS Eliot said of a line from Dante, “His will is our peace”, that no person who did not share Dante’s religious convictions could really comprehend its ultimate meaning ...... Bronowski says, “It is something that his whole heart and intellect entered into: for him it was a tremendously important line. ...... Of course, it is a great problem about works of art which utter such statements [as Dante’s] that they lack the kind of imagery that sets us on fire.” (Bronowski, 1966, p154)

I don’t think Bronowski, nor do I, mean to imply that Dante was a man of rigidity in his religious convictions. His work, The Divine Comedy, which includes Inferno, Purgatorio and Paradiso express his universality of mind, not narrowness of conviction. Bronowski makes clear, as he has on many previous occasions that, “the work of art ...... is an experience in living which you enter into because the painter’s or the poet’s imagery entrains you so that you are suddenly aware that the person whose picture this is, or whose experience this is, is in some way the same person as you” (Bronowski, 1966, p155)

Bronowski wants to distinguish between a religious conviction which in this case is not as such held by Dante, and the flexibility or fluidity of the experiment in imagery. This distinction, I do agree, is an essential difference
between the rigidity of conviction and the flexibility of imagery. The segment *Knowledge or Certainty* in the *Ascent of Man* is relevant here, and later in this lecture, Bronowski deals with the propagandist.

Bronowski illustrates the experiment in living, to use his expression when he says, "when you look at the Van Gogh, [photo 21, lecture 6.5] you really have to say to yourself, "well you know cutting off your ear is going a bit far, but I do understand how this could happen to a human being." This is what I call the work of art as an experiment in living." (Bronowski, 1966, p156)

I would like at this point in Bronowski's presentation to his listener or reader to stop and consider the title, "*The Play of Values in the Work of Art.*" When I first read the title I thought it pedantic, but now I have come to understand the word "Play" in the title. "Play" ranges from the games that our imagery allows us to have – children who play at being doctors, nurses and patients to try out the actions, to play of values in the work of the artist, to lead to values as expressing ethics, ways of behaving and living to enhance our society. The very title *The Play of Values in the Work of Art,* is an example of what Rita Bronowski called “the bright ribbon of imagination” in her husband Jacob’s work.

Bronowski himself goes on to illustrate, in a very clear way, the difference between “propaganda or obviously comic”, (Bronowski, 1966, p156) and writing and art as experiences of living. The comic he illustrates by drawing upon WS Gilbert of Gilbert and Sullivan who wrote a poem called *Emily, John, James and I,* which begins

*Emily Jane was a nursery maid*

*James was a bold Life Guard,*

*And John was a constable poorly paid*

*(And I am a doggerel bold).*

(Bronowski, 1966, pp156-7)

Emily tells the men that if they go to Epsom she will decide who to marry and Bronowski says this is a “falsification of life, it suggests that the most important things in life are decisions. Now that is all very well for company directors, but for most people the most important things in life are obviously
the experiences out of which decisions in the end have grown ..... I would contrast with *Emily, John, James and I*, a poem by WB Yeats called, *The Three Bushes*. Bronowski continues. “It is a splendid poem, a troubadour legend, about a woman who is in love with a man and is consumed with this love, and yet, since she is a stately married woman, she is also certain that she cannot sleep with him. Faced with all these troubles what does she do? She says to the lover, “We can only go to bed in the dark”, and then gets her maid to substitute for her on these carnal occasions. [Certainly an utterly different situation from Emily Jane, the nursery maid, who will marry the man who takes her to the Epsom races.]

*Have no lit candles in your room,*

*That lovely lady said,*

*That I at midnight by the clock*

*May creep into your bed,*

*For if I saw myself creep in*

*I think I should drop dead.*

*O my dear, O my dear.*

*I love a man in secret*

*Dear chambermaid,” said she,*

*“I know that I must drop down dead*

*If he stops loving me.*

*Yet what could I but drop down dead*

*If I lost my chastity?*

*O my dear, O my dear.*

*So you must lie beside him*

*And let him think me there,*

*And maybe we are all the same*

*Where no candles are,*

*And maybe we are all the same*

*That strip the body bare.*

*O my dear, O my dear.*

After a year of this subterfuge the lover has an accident on the way to the tryst, the woman dies of heartbreak, the maid lasts for a long time, then confesses it all to a priest. The priest has her buried with them; three bushes
grew over the grave, which are now so closely intertwined that you cannot tell which is which. ..... the poem says something very deep about the life of people and something very deep about the fact that you cannot separate mind from body. No literature is ever made by a cartesian separation at the waist.” (Bronowski, 1966, p158) [My emphasis]

Reading this poem takes me back to Chapter 2, The Poet’s Defence, and to the poems of Yeats. What comes to mind from the Yeats’ volume which I discussed in that chapter was the poem, An Irish Airman Foresees His Death, some lines from which are:

I know that I shall meet my fate
Somewhere among the clouds above;
Those that I fight I do not hate.

Bronowski takes on the consideration of Play of Values, after The Three Bushes, saying, “..... the next question obviously is, how do you direct your life? If the poem does not tell you how to decide between two lovers, what good is it ..... When we say that the work of art is an experiment in living, we mean exactly that it presents to us the pros and cons, what it feels like to be a murderer or a victim as a result of which you feel somehow that you have entered into the lives of other people. What is it that you get, other than merely sharing the sense of other people’s lives? You get what I have called in the title of this lecture, The Play of Values. You see neither science nor literature consists of just solving problems. In science, there are many cases where the solution to a problem does get you a step further, just as there are points in one’s life where decisions have to be made. But in the last analysis, neither the progress of science nor the content of imaginative work of literature simply faces you with a problem-solution and takes you out on Derby Day and says ‘Now make up your mind.’” (Bronowski, 1966, p159)

Bronowski continues, “..... one looks into the future, not by regarding it as a closed, bounded plan which is supposed to reach a precise objective, the solution of a problem, but as an open, unbounded, unfolding plan in which one sees one’s life ahead and one says to oneself, “I would like to lead this kind of life.” And then you ask, “Well that is fine. What are you going to do about it?”
The answer always is. "What I am going to do about it is to guide myself by certain general ethical rules of conduct." (Bronowski, 1966, p160)

Bronowski continues, "I think that all ethical values have this character. The sense that we see in other people facets of our own personality and to some of them we attach value; love, loyalty, intimacy, comradeship, efficiency, skill, penetrating thought, an ability to say things well, an ability to make you laugh. And there is more of an ethic in saying about somebody, "I think he is a gorgeous person, he makes me laugh, than (if you will forgive my saying so) exists in several of the Commandments. In that sense, then, what I call "ethical values" are a strategy of life, but I want you to understand that the word, "strategy" is not intended to have the sense of elaborate planning and problem solving – what I mean is a general conduct of life. The crucial thing about such values is that, in the last analysis, by some of them can you rule your life." (Bronowski, 1966, p161).

Bronowski proceeds to consider conflict of values by rewording an extensive poem by "contemporary Greek poet, CP Cavafy, about Darius and his court poet to come to the assertion, "The balance of values in the work of art is something which I have exhibited to you in a number of poems, particularly you will recall, in the poem by Dylan Thomas in which we constantly came upon the fact that when one is young it is wonderful to grow older, but when one is old it is very sad to grow older." There is a poem by EE Cummings [1894-1962] in which you get just that same contrast to which I pointed in the poem by Dylan Thomas; the tendency to put side by side two words of opposing meanings to get this effect. This is Cummings’ writing about his father:

My father moved through dooms of love
through sames of am through haves of give
Singing each morning, out of each night
My father moved through depths of height,

(Bronowski, 1966, p163)

Bronowski quotes the seven stanzas but I have presented the first one only because it is sufficient to show the contrast of words, just as the first of Dylan Thomas’s was sufficient.
In the first stanza of Cummings there are the contrasts, “dooms of love”, “haves of give,” “depths of heights.” A balance of values.

Bronowski explains that, “The force of this poem to me is that Cummings recognises that when he was a child his father stood for all those opposing things, the depths and the heights, the sea and the uplifting, the stars and the sun, and the joy and the misery. And what seemed so marvellous about his father is that somehow his father would make it all right, everything would be resolved by that touch, by that dream.” (Bronowski, 1966, p164)

Bronowski now moves towards the life goal of The Play of Values in the Work of Art. He says whether it is his own eleven year old daughter who listens to his recital of a poem about Emily Jane or Cummings who recognised the opposing things that his father said, and which seemed “so marvellous” that “you have to grow up and you have to become a person in whom these oppositions are worked out so that they do not tear you to pieces …… you will never make your life work if you think it is going to work in a simple plan. If you really think that saying, “I am going to be loyal to this, and it is going to serve me through life” will work, it just does not.” (Bronowski, 1966, p164)

To give force to his assertion, “it just does not”, Bronowski calls on the experience of Albert Einstein and the atomic bomb. Bronowski said, “Einstein was a pacifist all life. In 1939, Szilard and Fermi persuaded him to write a letter to Roosevelt saying, “It looks as if the Germans are making an atomic bomb and that being so, we really cannot neglect this threat.” Well now, it took a great deal to make Einstein sign the letter but he – a lifelong pacifist – signed it. And at the end of the war when, against his wishes and Szilard’s, the bomb had been used he said, “If I had known the Germans had not got any way at all, I would not have lifted a finger.” (Bronowski, 1966, p164)

Now what Bronowski says is important in understanding the Play of Values. He says, “Of course, if you always know what the others are doing, life is very simple. But at a given moment you have to make some kind of decision, and very often you have to live the rest of your life with the fact that your decision may have been wrong. And it is useless going about eating your heart out over a wrong decision. Like Einstein, you must shrug your shoulders and say, ‘That is how it went.’” (Bronowski 1966, p164)
As an example of the inability to shrug your shoulders, Bronowski refers to J Robert Oppenheimer. I will not go far in considering Oppenheimer as an alternative to Einstein’s reaction of shrugging his shoulders, but simply as Bronowski says, “Oppenheimer [important in the atomic bomb research period] as a delightful person who shares all our doubts in every direction. And yet at the same time, you see, he wants to make history. History is made by bigots. People of wide and generous views make science and poetry and many imaginative arts. But you have just to make up your mind. If you want to make history you must be a person, and you must have all these feelings. It is not a matter of heroics. It is really a matter of a profound sense of reflecting in yourself those aspects of humanity. Oppenheimer did that, but he also wanted to be on the President’s Advisory Council. Einstein did not want that.” (Bronowski, 1966 p165)

At this point, following his practice in the Mellon lectures, Bronowski provides six paintings to illustrate the lecture. I have, as is my practice, selected two of them, first Tiepolo’s *Queen Zenobia Addressing her Soldiers* and then Renoir’s *Les Paraplitès*.

*Figure 7.24 “Queen Zenobia Addressing Her Soldiers”, Giovanni Battista Tiepolo. Samuel H Kress Collection, National Gallery of Art, Washington, DC. (No date)*
I selected this painting because it is so obviously an arousing, recruiting, if I can use that word, war picture, remarkably like the picture of Mussolini in chapter 5 of the thesis. Bronowski describes it, as “propaganda.” (Bronowski, 1966, p165)

And then, in contrast, I selected Renoir’s picture because it is full of human experience and interplay of people.

*Figure 7.25 “Les Paraplites”, Pierre August Renoir. Reproduced courtesy of the Trustee, The National Gallery, London.*

Bronowski describes it as “the world of nineteenth century intimacy and pleasure particularly of the relations between man and woman ..... it is a spectrum of life, in such contrast to the obvious, simplistic Queen Zenobia.
In conclusion Bronowski says that, “There are two phrases about the play of values, that I used earlier, on which I would like to end. One is that the human predicament is not that each of us is alone but that the problems of life have no unique and final solution. And the other is that the play of values in the work of art really says that we recognise ourselves in the artist as one of his creations and we recognise the whole creation in ourselves.” (Bronowski, 1966, p169)

And on the subject of aesthetics, based on ethics, Bronowski says “My view is that there is no such thing as a single good, and that ethics consists of a clear and unsentimental register of values which cannot be arranged into a single hierarchy, to be called ‘the good’. You must always feel that you are exploring the values by which you live and forming them with every step that you take. On that I think beautiful is founded. That, I think is what the work of art says.” (Bronowski, 1966, p170)

7.9 Summary

Having come to the end of my writings on The Visionary Eye I would like to say that I think Rita Bronowski’s belief in the “bright ribbon of imagination” is what determined her choice of essays and lectures. Rita Bronowski recognised the personal duty of her husband Jacob, to present humanity as an everlasting struggle to develop good human relationships to enhance the dignity of societies. As Jacob said, or rather cried out, as he stood in a pool of ashes of victims of the crematoria at Auschwitz: “We must reach out and touch people.”

My writing of the sections of chapter 7 from The Nature of Art to the AW Mellon lectures, have been done with Rita Bronowski’s desire to illustrate the “bright ribbon of imagination” in her husband Jacob’s work. The principal concept in Bronowski’s work, whether in men, women or children is in their self expression in art (poetry, painting, music, sculpture) and in science (looking out of ourselves to the world around us). The meaning of the title Living is a Play of Values taken from lecture 6 in the Mellon lectures is the interaction of each person with themselves and their society in their daily life.
Epilogue

What I set out to do in the thesis on Jacob Bronowski began back in the 1970’s. It was the habit of my wife Elizabeth and me to watch the evening TV after dinner but on the evening in question, my wife watched and I was in my study completing reports on some clients I had seen that day in my practice in clinical psychology.

My wife called to me, “Peter, come and watch the man in this BBC programme on the ABC.” I left my study, sat down to watch the TV. The programme was the first of thirteen episodes titled The Ascent of Man, A Personal View by J Bronowski. It proved to be an absorbing series from the grunions on the beach at La Jolla up to events such as Hiroshima and Nagasaki, Nazism, DNA research and so on.

Having been introduced to Bronowski in 1973, 20 years, I began an MPhil, now a PhD. I began with Chapter 1, A Panorama of Bruno’s Lifelong Intellectual Struggle which contains his beginnings as the eldest of three sons of an “Old Testament” father from the “dark” ghetto of Warsaw, via Germany to England in 1920, knowing no English, on to Central Foundation School to Cambridge University, graduating with a PhD in Mathematics in 1933, becoming a naturalized British citizen. Fundamental to Bronowski’s career of contribution to humankind is his statement that “Being a Jew meant to me having a profound sense of intellectual values. It meant being tolerant of the thoughts of other minds, not out of indifference, but of respect and above all out of self respect.”

The optimism, openness, courtesy, respect derived from his Judaism had the other side of responsiveness to the “boney” English language of “civilized” English
minds and this leads to Chapter 2, the study of a 1966 edition of a book about eight “admired” poets, *The Poet’s Defence*. The poets range from Philip Sidney in the Court of Elizabeth I up to the 1933 Nobel Laureate, WB Yeats. Bronowski in *As Reasoned as Geometry* [the title of the chapter] offers his explanations of their poetry. There Sidney promotes *Virtue* as against “infected wit” as his ethics; John Dryden is distressed by the disasters of society, especially government; William Wordsworth values the integrity and pleasure of rustic life; S Taylor Coleridge “the best part of human language properly so called is devised from a reflection on the cast of the mind itself,” Shelley promoted “love thy neighbour” in his verse; AC Swinburne, together with AE Housman, sought a “pure poetry which shall not think”; while WB Yeats “made his fame with a soft and formalized verse”.

So *The Poet’s Defence* was not an anthology but allowed the eight poets to explain themselves, from poetry as ethics from Sidney, right through to poetry of the twentieth century. As the preface to the 1966 edition showed, Bronowski’s enthusiasm for the ‘boney’ English language and his skills in language enabled him to reach out to science and the arts.

Chapter 3 discusses the first Romantic poet, William Blake, 1752-1827, who through Bronowski’s delight with the ‘boney’ English language, showed personal courage, initiative and visionary ideas during the Industrial Revolution. Blake was a brave man who wrote verse about the Satanic Mills of the iron masters, cotton mills, coal mines, when the Tory government destroyed the personal dignity of the agricultural worker and cottage weaver. Bronowski’s presentation of William Blake makes this a powerful chapter. In summary, Blake’s courage is in these lines when he wrote:
I must create a system or be enslaved by another man's
I will not Reason and Compare: my business is to create.

(Blake, in Bloomsbury Poetry Classics, 1994, pix)

Chapter 4 covers the period when Bronowski was Scientific Deputy to the British Chief of Staff, and was required to visit Nagasaki after the destruction of the atomic bomb. He says his book Science and Human Values was born at that moment. It covers Bronowski and his Epistemology and his study of "human specificity". He specifies The Creative Mind, The Habit of Truth, The Science of Dignity to develop his move to biology and to further his interest in "human specificity."

Bronowski joined the Salk Institute, in California in 1964. In 1974, in the last months of his life, Bronowski was interviewed by a Visiting Salk Fellow, George Derfer and the content of the discussion links science, art (especially poetry) and human specificity to give knowledge, the basis of Bronowski's epistemology. He emphasises to Derfer that there is no value free knowledge. All knowledge is generated by the person who is responsible for it and its consequences.

Bronowski develops further his epistemology in the four lectures The Identity of Man (1965) given to the American Institute of Natural History. The four lectures are:

i) A Machine or Self
ii) The Machinery of Nature
iii) Knowledge of Self
iv) The Mind In Action

The lectures cover Bronowski's belief that humans desire to be free, to be themselves, subject to some biological restrictions. As well, the public has a responsibility for a good society as a social organization, allowing human
freedom. Here is Bronowski seeking to reach out to people from the pool of ashes at Auschwitz.

Chapter 5 is complementary to Chapter 4; epistemology, now associated with social behaviour is a theme. It begins with his BBC play *The Face of Violence* and goes on to *The Origins of Knowledge and Imagination*. The play is preceded by six essays which consider the meaning and expressions of violence turning to evil. The play *The Face of Violence* written by and described by Bronowski as “A Portrait of the Motives and Manifestations of Violence in Modern Society”. The play climaxes when Clarissa, whose young son was murdered by enemy prison guards; marries the prison guard, a deprived man himself, and says “and we've learnt that nothing remains to be discovered except compassion.” Clarissa’s values on compassion relate the play *The Face of Violence* to Chapter 6 *The Ascent of Man* where Bronowski kneels in the ashes of Auschwitz victims and pleads for us to “reach out and touch people”.

As part of Bronowski’s “reaching out” he gave the 1967 Silliman, Yale lectures on “human specificity”; thus the series of lectures came into publication as *The Origin of Knowledge and Imagination*. In subject and sensitivity, there is *Science and Human Values*, then *The Identity of Man* and the *The Origin of Knowledge and Imagination*, each developing depth and sensitivity in understanding the human condition in science and the arts, particularly the language of science, as “coded messages”, in a self referential epistemology.

Jonas Salk, said of Bronowski that “He was …. an interpreter of life communicating with artistry the hopes of man as well as the realities with which he must cope.” And as Christine Russell said, “Bronowski spent 66 years rehearsing for *The Ascent of Man*, the 13 part TV and book series on life from the grunions (fish at La Jolla, San
Diego) to reaching out to distinguish Knowledge or Certainty. Towards the end of the Ascent, in part 13 on The Long Childhood, Bronowski concludes “.... The ascent of man is always teetering in the balance .... Knowledge is not a loose leaf notebook of fact. Above all, it is a responsibility for the integrity of what we are, primarily of what we are as ethical creatures. You cannot possibly maintain that informed integrity if you let other people run the world for you while you yourself continue to live out a ratbag of morals that come from past beliefs”. (from Bronowski, The Ascent of Man, p436).

Chapter 7, titled The Visionary Eye is a collection of essays and lectures put together by Piero Arioti and Rita Bronowski, especially Rita, his widow, to illustrate the “bright ribbon of imagination” so characteristic of her husband Jacob’s life work. The titles of Jacob’s essays/lectures that Rita chose are The Nature of Art, The Imaginative Mind in Art, The Imaginative Mind in Science, The Shape of Things, Architecture as a Science and Architecture as an Art. Then Art as a Mode of Knowledge the powerful series of the A W Mellon lectures in Fine Art for 1969 under he heading “Art as a Mode of Knowledge”. Bronowski said in the first of the six lectures, “I propose to say in these lectures that the arts are a most important carrier of knowledge .... Into human experience and through that into human values, which to my mind makes this one of the fundamental modes of human knowledge.” (Bronowski, 1969).

For the purpose of the Epilogue it is not necessary to work through the six lectures – these are discussed in chapter 7, but I do think the title of the sixth lecture should be given it is The Play of Values in the Work of Art. I think this title has such flexibility for the reader or listener to ponder that it is what Rita Bronowski
meant by her husband’s “bright ribbon of imagination.” A person guides their life by their ethical values.

I will conclude the Epilogue, extended as it is, by recording Bronowski’s saying, “I think that all ethical values have this character. The sense that we see in other people’s faces of our own personality and to some of them we attach value: love, loyalty, intimacy, comradeship, efficiency, skill, penetrating thought, an ability to say things well, an ability to make you laugh ....” (Bronowski, 1966).

I will always value Bronowski. The study of Bronowski himself as a person, as well as his ideas through the production of my thesis over several years, has helped me over the last few years to accept the loss of my dear wife and recently the demise of my 17 year old cat, and to maintain courage and optimism as Bronowski would say. I recall, from the segment Knowledge or Certainty in The Ascent of Man Bronowski, standing in the ashes of the victims of the Auschwitz crematoria, reaching out and appealing to people to “touch each other” to maintain their humanity. I think back to the 1970’s, as I recorded in the beginning of the Epilogue, my wife calling me to come and watch the TV programme made by the BBC, and shown on the ABC. Bronowski in presenting A Personal View reached out and touched my wife and me. The Epilogue has come full circle.

Peter Sarfaty

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