

POPULARIZING SCIENCE: THOMAS

HENRY HUXLEY'S STYLE

By

MAHALINGAM SUBBIAH

Bachelor of Science
Annamalai University
Tamilnadu, India
1970

Bachelor of Education
Annamalai University
Tamilnadu, India
1971

Master of Arts
University of Madras
Tamilnadu, India
1978

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
December, 1987

Thesis
1987D
S941p
cop.2



POPULARIZING SCIENCE: THOMAS
HENRY HUXLEY'S STYLE

Thesis Approved:

Thomas H. Ware

Thesis Adviser

Sherry Southerd

William H. Peyton

Philip E. Paulin

Edward P. Walker

Noorman R. Durham

Dean of the Graduate College

PREFACE

Thomas Henry Huxley, the major scientific popularizer of the nineteenth century, spent most of his time and energy disseminating scientific information to the upper and middle class intelligentsia as well as to the artisan class. He traveled throughout England, went across the Irish Sea, and came to America to address lay audiences. All the popular magazines of his time published his articles on science. His name was so familiar to the public that in 1894 Andrew Lang, the folklorist and man of letters, remarked, "In England when people say 'science,' they commonly mean an article by Professor Huxley in the Nineteenth Century" (qtd. in Cyril Bibby Scientist 101).

Whether through an article in the Nineteenth Century or a Friday Evening Lecture at the Royal Institution, Huxley was able to communicate successfully with the public because of his philosophy of public speaking, his personality, and his lucid style. He was eloquent, honest, open minded, and he firmly believed that he could convince honest and intelligent persons by putting in front of them the same plain facts by which he was convinced. He respected the experience and intelligence of his lay audiences and never looked down upon nor talked down to them.

In addition to his philosophy of public speaking,

Huxley's physical traits, as suggested by Chalmers Mitchell, appealed to his audiences. He was erect and strong. His piercing eyes, firmly set, trap-like mouth, and well modulated voice made the audiences riveted to his speeches until he finished (209).

Comparatively few had the opportunity to listen to Huxley's speeches, but his writing reached thousands because of its refreshingly easy and remarkably lucid qualities. He excelled in all aspects of writing style. Logical organization of ideas, clear and precise expressions in common terms, simple illustrations from day to day life, graphic descriptions of even complex mechanisms--all contributed to his rich expository prose. He considered science and literature as the two sides of the same coin. His interest in English literature (Shakespeare, Browning, Tennyson, and Carlyle were some of his favorites) helped him stamp his literary mark on scientific prose. The influence of the great writers on Huxley's scientific prose deserves a separate study. Because I restrict my focus to Huxley's popularization techniques--his adaptation to disparate readers--such analysis falls outside the scope of my dissertation.

Though the literary qualities of Huxley's scientific prose have been generally admired, only a few articles have been written on his prose style. While these analyses focus on some of Huxley's scientific and social and philosophical essays, there is no separate, full length, stylistic study

of his scientific prose. Therefore, I propose to analyze his popular scientific books and essays looking for the various stylistic techniques that he adapted to suit the educational and social backgrounds of his readers.

Most of Huxley's popular scientific prose, published in the multiple volumes of Collected Essays, was first written as speeches, but changed into written form later. Yet some of the speeches, such as his six lectures to the working men, were published, as Huxley himself admits, "without any changes" ("Preface," Collected Essays 2: vi). The information, if there is any, about the changes he must have apparently made in the other speeches when he published them is not available. Because of this difficulty in distinguishing his popular scientific speeches from essays, I shall treat his prose including both types of communication situations.

The first chapter of this study will place Huxley in the nineteenth-century milieu to shed light on the educational and social conditions that led him to take up popularizing. This chapter will illustrate the conviction, dedication, and determination with which Huxley took science to the masses. This chapter will also provide a brief review of the few articles on his style.

The second chapter will focus on one of the basics of successful communication: audience analysis and adaptation. From Aristotle to contemporary writers, this subject has merited attention from different perspectives. This chapter

will review those perspectives, providing a basis and the critical tools necessary for analyzing Huxley's prose.

The third chapter will illustrate Huxley's awareness of audience by providing evidence from within his writing as well as outside of it. Once a communicator knows as much as he can about his audience, he may effectively adapt his subject matter to suit the background of his audience. The fourth chapter, therefore, will highlight Huxley's content adaptation.

To deliver a subject matter clearly, a successful communicator needs to devise suitable strategies. Hence, the fifth and sixth chapters will deal with the various techniques Huxley adapts to convey his ideas clearly to his audiences.

The concluding chapter will summarize the characteristics and techniques of Huxley's prose that made him the major scientific popularizer of the nineteenth century.

I am indebted to my advisory committee members Dr. Thomas Warren, Dr. Sherry Southard, Dr. Edward Walkiewicz, Dr. William Pixton, and Dr. Ed Paulin for their criticism, suggestions for improvement, and cooperation during various stages of my dissertation. I am also thankful to the Oklahoma State University library for its interlibrary loan facility through which I was able to get materials from as far away as Canada. Finally, I owe a great deal of gratitude to my parents, who encouraged and wished me well

from thousands of miles away, and my wife, who helped me in more than one way to bring this dissertation to fruition.

TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION: FROM EXPERIMENTOR TO EXPOSITOR OF SCIENCE.....	1
A Promising Scientist.....	1
A Prominent Popularizer.....	5
Popularizing: Aiming at all Sections of Society.....	13
Literature Review.....	18
II. BASICS FOR SUCCESSFUL COMMUNICATION: AUDIENCE ANALYSIS AND ADAPTATION.....	30
Audience: Isolated Phenomenon.....	33
Audience: Participant in the Communication Process.....	41
Audience: An Aspect of the Communication Process.....	48
Audience: From Analysis to Adaptation.....	50
Thomas Pearsall and Kenneth Houp: Combining Traditional Analysis with Content and Stylistic Adaptations.....	54
Audience Analysis Is an Art.....	58
III. HUXLEY'S AWARENESS OF AUDIENCE.....	60
Awareness of Audience's General Background.....	60
Awareness of Audience's Specific Background.....	65
IV. CONTENT ADAPTATION.....	84
General Discussion of Huxley's Content Adaptation.....	86
Detailed Discussion of His Content Adaptation Techniques.....	89
Huxley's Content Adaptability: From a Different Perspective.....	103
V. STYLISTIC ADAPTATIONS I.....	115
Scientific Windows.....	116
Commonplace and Local Examples.....	123
Figures of Speech.....	131
VI. STYLISTIC ADAPTATIONS II.....	142
Peopling Passages, or Human Interest.....	142
Huxley's Language.....	159

VII. CONCLUSION: REASONS FOR SUCCESS.....166
WORKS CITED.....176

LIST OF FIGURES

Figure	Page
1. A Transactional Systems Model of Communication.....	43

CHAPTER I

INTRODUCTION: FROM EXPERIMENTOR TO EXPOSITOR OF SCIENCE

If I may speak of the objects I have had more or less definitely in view . . . they are briefly these: To promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction . . . that there is no alleviation for the sufferings of mankind except veracity of thought and of action, and the resolute facing of the world as it is. . . .

It is with this intent that I have subordinated any reasonable or unreasonable ambition for scientific fame . . . to the popularisation of science; to the development and organization of scientific education.

- T.H.Huxley, "Autobiography"

A Promising Scientist

"Reasonable or unreasonable ambition for scientific fame" is an expression that does not truly reveal Huxley's

scientific potential in his late twenties. His desire to become a scientist was very reasonable; Sir Michael Foster and Prof. Ray Lankester in their preface to the collected edition of Huxley's *Scientific Memoirs*, account for his scientific fame. These memoirs, they wrote, show that

the progress of biology during the present century was largely due to the labours of his of which the general public knew nothing. . . . He was in some respects the most original and most fertile in discovery of all his fellow workers in the same branch of science. (ii)

With his originality and fertility in discovery, Huxley could have become a well-known scientist of the nineteenth century, had he so desired.

Huxley had shown all the promise of a budding scientist at an early age. In 1844, when he was nineteen, he joined the community of scientists by discovering and reporting the existence of "Huxley's Layer," an inner membrane in the root of human hair. By 1849, he joined the ruling scientific fraternity of Sir Joseph Hooker, the botanist; John Tyndall, the physicist; Herbert Spencer, the philosopher; Sir Richard Owen, the anatomist and paleontologist; and Charles Darwin. Houston Peterson records Huxley's achievement at this stage of his life. When the scientific world had confronted the difficulty of examining the delicate jelly fish and was confused about its structure, Huxley successfully dissected these sea creatures and made their anatomy known to the

world. He discovered the two membranes of invertebrates (later named as ectoderm and endoderm) and showed, for the first time, the relationship among the members of the Family Medusae. Peterson goes on to say,

At the age of twenty-five Huxley found himself within the inner sanctum of British science. The leading scientists of the day not only appreciated what he had done, but the great possibilities in what he would do. They could not doubt the powers of that tall, dark, severe young man. He was to become a giant among them--and he knew it much better than they. (45)

Huxley was aware of his scientific potential and his future career. He wrote to his fiancée, Miss Heathorn, in July 6, 1853:

My course in life is taken. I will *not* leave London. I *will* make myself a name and a position as well as an income by some kind of pursuit connected with science, which is the thing for which nature has fitted me if she has ever fitted any one for anything. (emphasis added) (L. Huxley 1: 91)

As early as 1851, he wrote to William Macleay, the distinguished biologist of Sydney:

I have finally decided that my vocation is science. . . . For a man of my temperament . . . the sole secret of getting through this life with

anything like contentment is to have full scope for the development of one's faculties. Science alone seems to me to afford this scope. (L.

Huxley 1: 101)

He was not wrong in his prediction.

Huxley was accepted in the Royal Society at twenty-six, was awarded the Society's Gold Medal at twenty-seven, and was recognized, as Albert Ashforth points out, "as the brightest star in the galaxy of England's young natural scientists" (18). He was later elected the secretary and then the president of the Royal Society, the most distinguished position a scientist could attain in nineteenth-century England. In fact, James Richard Ainsworth Davis, writing in 1907, says that Huxley's claim to a prominent position among the great men of Victorian era will, in all probability, chiefly depend upon "the inestimable value of his astonishingly numerous contributions to scientific research" (277). He says elsewhere that Huxley may be considered as the inheritor of the tradition created by Johannes Müller and Von Baer, the respective founders of comparative morphology and embryology (245).

Huxley's purely scientific research was not only valuable but also diversified, leaving his mark on almost every important group of the animal kingdom. His contribution to science extended to diverse disciplines such as marine zoology, taxonomy, comparative anatomy,

paleontology, and glacial geology. At the International Congress on Zoology in 1895, Professor A. Kowalewsky paid an emphatic tribute to Huxley upon his death:

In the person of Huxley, science has sustained a great loss. We do not know any other investigators of our century who had the talent of foresight to such an extent as Huxley. It was he who, properly speaking, founded modern embryology by demonstrating the homology of the germinal layers of Vertebrates with the ectoderm and endoderm of Coelentrates. It was he who supported Darwin on the publication of the fundamental work on the origin of species, and it was he who was the fervent propagator of the view therein contained. The two names of Darwin and Huxley have built up the story of the scientific world.

(651)

A Prominent Popularizer

The turning point in the young scientist's career came after the publication of Darwin's On the Origin of Species. Huxley wrote book reviews and articles for various popular magazines such as The Westminster Review before the publication of the Origin; nevertheless, he earnestly attempted to reach lay audiences only in 1859 when Darwin had published his book. The opposition to Darwinian evolution from influential clergymen forced him to assume

the role of an advocate for Darwin. His first step in the new role was to take the astonishing scientific development to the masses. He made his first lecture entitled "On the Persistent Forms of Animal Life" at the Royal Institution in June 1859.

Huxley took on himself the role of an advocate for Darwinism because, of all the theories of evolution forwarded, Darwin's concepts of struggle for survival and natural selection were the most convincing to him. When the Origin was published, Huxley revealed the delight of the scientific community:

The publication of the Darwin and Wallace paper in 1858 [read before the Linnaean Society], and still more that of the Origin in 1859, had the effect . . . of the flash of light which to a man who has lost himself on a dark night, suddenly reveals a road which, whether it takes him home or not, certainly goes his way. . . . None of us had suspected that the road to the heart of the species problem lay through them, until Darwin and Wallace dispelled the darkness, and the beacon-fire of the 'Origin' guided the benighted.

(Frances Darwin 2: 189)

While convinced of the greatness of the theory, Huxley also warned Darwin of the annoyance and abuse that he might have to face from the creationists and the public. Huxley's personal traits--adherence to truth and commitment to speak

it, a love for controversies, and a fighting spirit--all drove him into the center of the controversial debates on evolution that ensued after the publication of the Origin. Assuring Darwin of his personal support, he wrote

I trust you will not allow yourself to be in any way disgusted or annoyed by the considerable abuse and misrepresentation which, unless I greatly mistake, is in store for you. Depend upon it, you have earned the lasting gratitude of all thoughtful men; and as to the curs which will bark and yelp, you must recollect that some of your friends, at any rate, are endowed with an amount of combativeness which . . . may stand you in good stead. I am sharpening my claws and beak in readiness. (France Darwin 2: 27)

Prepared to face the theologians and a few hundred educated listeners, Huxley took the opportunity that the Times provided for him to reach thousands of general readers. A month after the publication of the Origin, in his review of Darwin's book in the Times, Huxley recalled: "I was too anxious to seize upon the opportunity thus offered of giving the book a fair chance with the multitudinous readers of the Times" (L. Huxley 1: 231). In a letter to Hooker, written a few days later, he disclosed his reason for taking the opportunity: "I earnestly hope it may have made some of the educated mob, who derive their ideas from the Times, reflect. And whatever they do, they

shall respect Darwin" (L. Huxley 1: 190).

Huxley was right about the prejudices the theory of evolution had to overcome. He spent the next thirty years of his life enlightening as well as educating the public about Darwinism. The doctrine of descent, what Carlyle called a "monkey damnification of mankind" (qtd. in Chalmers Mitchell 111) came as a great shock to the sentiment of the nineteenth century public. The conception that man is a "noble creature" seemed to have been mutilated by this theory. Ideas and concepts such as emancipation of slaves, political freedom, the right of all to education, and other political and philosophical notions which were based on the ideal of universal brotherhood and unity of mankind seemed to have fallen down to the ground when Darwin's theory struck the noble conceptions like a lightning.

It is no wonder it required a man of Huxley's nature--adherence to veracity of thought, commitment to educating the public with it, love for controversies--to fight a long battle, first to defend Darwinism, and then to expostulate it. Consequently, his attention was gradually turned away from pure scientific research to dissemination of scientific information.

Popularizing: Means to Earn Money

Huxley, the scientist, turned into the disseminator of science for another reason. His life in the early 1850s was full of anxiety and expectations. His initial days at

London, after he had returned from his sea voyage, were a financial struggle. He was receiving a small salary from the Royal Navy and was attempting to find a teaching position while pursuing his scientific research and publication. His letters written during this period reflect his concern for money. As early as March 1851, he wrote to his fiancée: "A man of science may earn great distinction, but not bread" (L. Huxley 1: 72). In another letter to her on May 4, 1851, he said,

My opportunities for seeing the scientific world in England force upon me every day a stronger and stronger conviction. It is that there is no chance of living by science. . . . A man who chooses a life of science chooses not a life of poverty, but, so far as I can see, a life of nothing, and the art of living upon nothing at all has yet to be discovered. (L. Huxley 2: 74-75)

A letter to his sister Lizzie, written a year after the preceding one, continues to reflect his concern: "Science in England does every thing--but pay. You may earn praise but not pudding" (L. Huxley 1: 108).

The anxiety for supplementary income forced him to write for popular magazines. In the letter to his fiancée written on May 4, 1851, he said, "In literature a man may write for magazines and reviews, and so support himself; but not so in science. I could get anything I write into any of the journals or any of the Transactions, but I know no means

of thereby earning five shillings" (L. Huxley 1: 74). As Chalmers Mitchell, Cyril Bibby, and Ashforth point out in their biographical works on Huxley, in addition to a small salary from the Royal Navy, he was trying to earn more by writing a book (A Manual of Comparative Anatomy) for the publisher Churchill and articles on contemporary science for the Westminster Review. But his services with the Royal Navy were terminated in 1854. However, the same year he was appointed at the Government School of Mines at 200 pounds per annum; the next year his salary was raised to 600 pounds. Afterwards, he assumed many teaching and other positions, and money was no longer a major concern.

Popularizing: Means to Educate Public

Once Huxley had begun teaching and addressing the public earnestly, he realized that the public was ignorant of science. One of the reasons for this state was the educational system. Quoting Charles Babbage, the Victorian critic, George Basalla and others complain, "It is . . . not unreasonable to suppose that some portion of the neglect of science in England may be attributed to the system of education we pursue" (10). Universities and schools of nineteenth-century England ignored science. Prior to the 1850s, the Universities of Cambridge and Oxford paid little attention to science. Classical literature and languages, theology, and mathematics completed the list of college courses.

The universities were not only indifferent but also hostile to science. As George Basalla reports, in 1832, when the British Association for the Advancement of Science held its annual meeting at Oxford, an Oxford professor, John Keble, derisively referred to its members as a "hodge-podge of philosophers" and remarked that the university had "truckled sadly" to the current interest in science. The public schools reflected the same view, and the elementary schools were no better either (11).

In fact, many Victorian scientists studied and carried on their scientific work outside of the universities. Some of these men were largely self-taught: Dalton, Faraday, Huxley, Joule. Others like Darwin and Lyell were university products but were critical of the educational system. Still others like Lyon Playfair and Tyndall felt it necessary to complete their training abroad.

Along with a concern for scientific education in schools, colleges, and universities, Huxley was also concerned about scientific education for the common people. If the defence of Darwinism forced him to take up popularizing, his concern for the scientific knowledge of the common people made it his chief objective in life. He was dismayed seeing "utter ignorance as to the simplest laws of their own animal life" on the part of the people, even in the educated. He gave vent to his feelings when he addressed them ("On the Educational Value of the Natural History Sciences") at St. Martin's Hall in London in 1854.

Huxley repeatedly pointed out to the public that science is nothing but "trained and organized common sense." He said in the St. Martin's Hall address, "the vast results obtained by Science are won by no mystical faculties, by no mental processes, other than those which are practiced by every one of us, in the humblest and meanest affairs of life" (T.H. Huxley Collected Essays 3: 45). He explained in the address that the deductive process by which Cuvier restored the extinct animals of Montmartre from the fragments of their bones is identical with the process of a detective who discovers a burglar from the marks made by his shoes. He reiterated his point by saying that the scientist uses the process with scrupulous exactness whereas the public uses them carelessly at every moment.

Huxley continued to speak on this line when he gave the Six Lectures to Working Men in 1863. He emphasized the point that "the method of scientific investigation is nothing but the expression of the necessary mode of working of the human mind." He said,

There is no more difference, but there is just the same kind of difference, between the mental operations of a man of science and of science and those of an ordinary person as there is between the operations and methods of a baker or of a butcher weighing out his goods in common scales, and the operations of a chemist in performing a difficult and complex analysis by means of his

balance and finely-graduated weight. (CE 2: 363)

As late as 1868, when Huxley was advocating liberal education, he pointed out the necessity for learning science in an address to the South London Working Men's College. He was convinced that human lives depend upon the world of nature around them. To live happily, human beings need to know the phenomena of the universe and the rules of nature that control them. If they understand their position, they can live safely; ignorance will only lead to their destruction, slowly but steadily. Thus, Huxley's popularization that began with the defence of Darwinism soon extended to other branches of science. His belief that science could alleviate the sufferings of mankind and his distress about the lack of scientific interest in the educational system and among the public led him to take up popularizing with commitment and determination.

Popularizing: Aiming at All

Sections of Society

With conviction, Huxley spent his life talking about science and on various scientific topics to young school children, college students, the middle and upper class intelligentsia, and working men. Huxley reached them through public addresses, many of which were published in various popular magazines. Also, he reached them by writing directly in popular magazines.

Reaching the Upper and Middle Classes

Huxley's public addresses include his Friday Evening Discourse at the Royal Institution to, what Bibby terms, "the fashionable intelligentsia" of London. Altogether he gave twenty-two Friday Evening Discourses on biology, evolution, embryology, human paleontology, ethnology, comparative morphology, and psycho-neurology. Office workers from the city attended his London Institution lectures that ostensibly dwelt upon subjects like animal motion, the pedigree of horses, and the elements of psychology. Other sections of the London public crowded at the Zoological Gardens to hear him speak on starfish, snakes, and squids.

In addition to the lectures in London, Huxley addressed the public in most of the important regional centers such as the Edinburgh Philosophical Institution. He gave two lectures in 1862 on the relation of man to the lower animals and later in 1869 on the unity of all living things, both plants and animals.

Huxley gave many lectures at the Birmingham and Midland Institute on the origin of mankind (1867), on the lowest forms of animal life (1868), and on fossils intermediate between birds and reptiles (1870). He delivered his Presidential Address to the Institute in 1871 and another address when he unveiled the city's statue to Joseph Priestley in 1874.

During the 1860s he lectured at Hull's Royal Institution on methods of paleontology, at Liverpool's Philomathic Society on scientific education, at the Leeds Philosophical and Literary Society on the ethnic diversity of England's expanding Indian domains, and at the Bradford Philosophical Society on coal.

Across the Irish Sea, at the British Association's Belfast meetings, Huxley gave his speech, "On the Hypothesis that Animals are Automata, and its History," which received high praise from the local newspapers.

Reaching Artisans

Huxley was class conscious. He was closer to artisans than he was to the other classes because, as he explained to the London correspondent of the New York Tribune, "I am a plebeian, and I stand by my order" (qtd. in G.W. Smalley 19). While many of his contemporaries were separated from the working class by the barriers of upper-class education and social experience, Huxley's middle-class background enabled him to have a strong affinity toward the working class.

Huxley was more enthusiastic in addressing the workers than the other audiences. He wrote to Dyster, his friend, "I believe in the fustian and can talk better to it than to any amount of gauze and saxony" (L. Huxley 1: 149). At the same time, however, he never talked down to the workers. As Bibby points out, "Huxley had a high respect for the

workers and made no secret of his conviction that here was a vast reservoir of potential ability only waiting to be set free by adequate education" (Adult Education 211).

For many years the British Association for the Advancement of Science made no attempt to reach beyond the middle and upper classes. But in 1866, when the Association decided to give a popular lecture each year for the benefit of the artisan class, Huxley explained the project amidst the cheerful greetings of the workers who assembled to hear him on short notice. In 1868, he delivered "On a Piece of Chalk," a brilliant piece of scientific popularization to the working men of Norwich.

In 1870, at Hulme Town Hall, Huxley delivered "On Coral and Coral Reefs" and a year later, at the Free Trade Hall, the organizers of Manchester's "Science Lectures for the People" enabled the workers to listen to Huxley on "Yeast."

After his appointment to the Government School of Mines in 1854, Huxley gave many lectures to workers at Jermyn Street on human races, bodily motion, the crayfish, the dog, and the oyster. His "On Our Knowledge of the Causes of the Phenomena of Organic Nature," a series of six lectures, is illustrative of his brilliant popularization skills.

Reaching the Student Community

In addition to the upper, middle, and working classes, Huxley reached different levels of students. Lessons in

Elementary Physiology, Physiography, Coral and Coral Reefs, and Man's Place in Nature had sold well in the educational market. Some of his books, for instance Physiography, have been translated in Russian, French, German, Polish, and Hungarian.

Reaching the Public through Popular Magazines

Huxley was busy in scientific journalism too. He started writing for The Westminster Review in 1894. He marshalled many of his contemporaries to publish in The Saturday Review. Since 1860 to its end in 1865, Huxley spent a great deal of his time writing for and editing the Natural History Review. Though its struggle and untimely end seemed to suggest that the British public was not ready for a semi-popular periodical dealing with science, Huxley was satisfied enough to introduce the first number of Nature in 1869. The objective of the publication was to place before the general public the results of scientific discovery, and to urge the claims of science to more general recognition in education and in daily life. For many years Huxley contributed to this periodical and took a fatherly interest in its editing.

Huxley's attempt to reach the general public continued through many other magazines such as Macmillan's, The Fortnightly Review, The Contemporary, and Nineteenth Century. He was always in demand and picked any periodical

that best suited his purpose. On occasions, he wrote for little-known magazines like Youth's Companion and thus was able to bring a better understanding of science and its methods to great numbers of all classes.

Literature Review

Scientist or Literary Man?

Huxley used both spoken and written forms of communication to reach the public, and his highly admired style made this task seem amazingly easy. Many Victorian critics consider his style to be classic. However, other critics deny him this stature, but admit that he was a great writer. Yet their disparate views center upon one question: Was Huxley a scientist or literary man? Some consider him to be a literary craftsman with a good style; others see him as a scientist who represented his ideas in clear English.

William Buckler in his "Introduction" to Prose of the Victorian Period analyzes the styles of Huxley and J.S. Mill. Praising them for their precision and clarity, he describes Huxley's style as livelier, more spontaneous, greater, and richer in literary allusion than that of Mill. He calls them only "journeymen" of high order, but not of great literary stature (xx). Chalmers Mitchell says in his biography of Huxley, "From the technical point of view of literary craftsmanship, he cannot be assigned a high place; he is one of our great English writers, but he is not a

great writer of English. . . . His style was a style of ideas and not of words and sentences" (217).

While Mitchell and Buckler do not assign great literary status to Huxley, G.K. Chesterton considers Huxley as "more a literary man rather than a scientist" (39). However, Aldous Huxley refutes Chesterton by identifying T.H. Huxley both as a literary craftsman and a scientist (47-83).

Scientist and Literary Man

Echoing Aldous Huxley in his brief general discussion of Huxley's style, Albert Ashforth marvels at the smooth blending of Huxley's scientific and literary skills. Referring to Huxley's "On a Piece of Chalk," he says, "Huxley, the scientist, invests the chalk with a significance heretofore unsuspected by laymen; Huxley, the essayist, describes and explains in terms that rival any piece of fiction for interest, suspense, and enchantment" (58). Revealing the "story" of the chalk, as if narrating an historic fiction by flashbacks, Huxley imaginatively takes his audience under the earth, across the vast, prehistoric land and oceans, to the origins of the chalk. In this process, he uses specific, common examples to illustrate general principles of science. Commenting on this singular approach to scientific popularization, Ashforth says that this quality "led Huxley to a lucid presentation of data and ideas that places him at the pinnacle of expository writers in English literature" (57).

Scientist and Choreographer

Like Ashforth, James Paradis too analyzes Huxley's style briefly with specific reference to his popular essays. Huxley's essays, claims Paradis, are "fine dramatic art." Huxley accomplished this quality by dramatically presenting material entities such as chalk, lobsters, coal, yeast, and protoplasm to stress the essential unity of organic and inorganic forms of existence in this world.

The common objects playact on the stage or within the framework of an essay under the direction of Huxley who becomes the scientist-choreographer. Thus, Huxley becomes, says Paradis, a stage manager of this material world, demonstrating a variety of existential truths. The controversial nature of the subjects, "electrifying motion of ideas, theatrical clash between tradition and new knowledge," and "a glimpse into the strange new universe that Victorian science had been quietly assembling"--all contribute, explains Paradis, to this dramatic quality of Huxley's prose (37-38).

Huxley's Language: Rhetoric

Unlike the preceding general critiques on Huxley's style, some criticisms deal specifically with certain stylistic aspects of his prose. One such aspect, which has led critics to form conflicting opinions, is Huxley's use of rhetoric. Referring to the complex stylistic temperament of

Huxley, Loren Eiseley remarks, "There are really two faces that comprise the face of Thomas Henry Huxley. The one in youth--sensitive, mobile, somewhat sad--is that of a poet. The other . . . could be the face of a great barrister . . . or a fighter who expects no mercy and gives none" (ii). It is the "barrister" or "fighter" in Huxley that used all the devices of rhetoric to his advantage.

However, earlier critics do not agree that Huxley used rhetoric at all. Their version of Huxley has the face of an honest controversialist scorning rhetoric, to whom, as his grandson Aldous says, "truth was more important than personal triumph" (64). Thus Aldous reacted to G.K. Chesterton's earlier remark that Lord Macaulay and T.H. Huxley "were both much more under the influence of their own rhetoric than they knew." When Huxley was charged with being a rhetorician, he expressed his horror of, as Chesterton points out, "plastering the fair face of truth with that pestilent cosmetic, rhetoric." Charging that Huxley's reply is itself a "well-plastered a piece of rhetoric," Chesterton reiterates his claim that Huxley did use rhetoric in his writings (39).

That Huxley used rhetoric has been established beyond doubt by later critics. "Though Huxley fulminated against rhetoric," Charles Blinderman asserts that "he used it." Huxley knew, continues Blinderman, that "polemical writing, though perhaps an evil, is useful 'when it attracts attention to topics which might otherwise be neglected'"

("Semantic Aspects" 175). It is with this intention that Huxley employed rhetorical devices such as rhetorical questions, rhythm, parallelism, antithesis, figures of speech, and allusions to myth, fairy tales, Bible, art, history, and literature in his writings.

The subtle employment of rhetoric, says Blinderman, is inconsistent with Huxley's advocacy of simplicity. Huxley strove to use "the language of the market-place when communicating ideas to people who frequented pubs" (171). He preferred concrete words and disliked abstract terms and word jugglery, or anything that might obscure his prose. While striving for clarity, he also strove for forcible expressions to heighten his persuasiveness, and it is in this striving that Huxley exploited various rhetorical devices.

The apparent inconsistency between Huxley's advocacy of simplicity and his practice of rhetorical subtlety, notes Blinderman, is due to "the tension developed between his desire as a scientist to be exact and cold and his need as a polemical writer to be persuasive and at times hot." However, Huxley achieved a graceful balance between clarity and effectiveness. Quoting from The Huxley Papers, Blinderman concludes that "For Huxley, as he writes of others, endeavored 'to add grace to force, and, while loyal to truth, make exactness subservient to truth'" (178).

Like Blinderman, Walter Houghton too analyzes the situations that forced Huxley to use rhetoric. Houghton

asserts that Huxley does not hesitate to employ rhetoric when he is convinced of the hollowness of his opponent's knowledge or the issue. Also, when he moves from straight exposition to generalization about the value of science or religion and to passages on scientists and clergymen, he was not at all hesitant to "bolster a shaky or biased argument . . . with the extra emotional influence . . . of exaggeration and insinuation." Sometimes, Houghton notes, Huxley is "suddenly swept by a gust of personal emotion which he cannot check or master." However, he does not condemn Huxley's tactics as "vicious or unscrupulous" or as those of "a slick politician with a party platform to defend." Rather they are the result of deep conviction on the part of an able and lucid exponent of one side (159-75).

While Houghton points out the situations that force Huxley to use rhetoric, Vernon Jenson lists the specific strategies that Huxley used to surmount the attacks of orthodox theologians. During the last four decades of the nineteenth century, orthodox theologians with their doctrines of supernaturalism and Biblical fundamentalism considered freethinkers as destroyers who attempted to bring to the ground the high superstructure of organized theology that had been slowly built over many centuries. Jenson argues that people like Ingersall and Huxley felt that orthodox theology was an obstacle to the progress of mankind and that they devised many strategies to win over the opponents. Jenson lists all the strategies that Huxley used

to this end in his essays (66-68):

- * Dividing the enemy
- * Associating him with evil allies
- * Attacking frontally with blunt accusations that the opponent was sinful in thought, word, and deed
- * Lowering the guard of the opponent prior to a heavy blow (not identifying himself with any person or group to avoid any derogatory effects of such association, reducing animosity in his audiences by using new terms for the revered concepts which he sought to destroy)
- * Inflicting small, sharp flank attacks through irony, understatement, and ridicule
- * Following a detailed and seemingly dispassionate and objective analysis with a sudden blow--a sharp strongly worded, partisan conclusion
- * Concentrating his fire on a precise area (singling out an episode as representative of a larger issue and then proceeding to shoot it full of holes)

Huxley's Language: Poetic

While Jenson and Blinderman analyze the rhetorical style of Huxley, Aldous Huxley and Joseph Gardener claim that Huxley did not use any rhetoric and that his poetic language is mistaken for rhetoric. Aldous Huxley, claiming that "much has been written in rather vague and general

terms of Huxley's style," undertakes to critique his grandfather's style in "definite and precise" ways. Huxley's prose, says Aldous, is poetic because his prose both in "scientific and emotive statements arouses aesthetic feelings" (60). Aldous classifies Huxley's writings into three categories: 1. purely descriptive, 2. philosophical and sociological, 3. controversial and emotional.

Aldous includes all of Huxley's scientific papers under purely descriptive writings. His studies of Hulme and Berkeley, and his essays on ethical, metaphysical, and educational issues fall under the second category, the philosophical and sociological. The third category consists of his essays on the Christian and Hebrew tradition, criticisms of other people's ideas, or defences of his own. However, these divisions, Aldous cautions, are not mutually exclusive. Categories one and two include strictly scientific writings, he says, in the sense that they deal only with facts and ideas, not passions. The third category, however, communicates information with feelings.

Since my focus is only on Huxley's scientific writings, I shall briefly summarize Aldous' analysis of the first two categories. Illustrating from Huxley's essay on crayfish, Aldous praises Huxley's lucid, descriptive style. This style is "plain and unadorned," but gives the reader "a satisfyingly accurate picture of what is being described" (68). Plain yet accurate, declares Aldous, is the strength of Huxley's purely scientific writings.

The second category, Aldous says, has "much higher potentialities of beauty than purely descriptive writings." These higher potentialities of beauty are the use of rhythmical effects, use of "caesura sentences," and sparse use of images. Quoting Huxley's explanation of scientific hypothesis, he illustrates the rhythmical use of long and short phrases which adds a poetic flavor to the passage.

Next, quoting Huxley's essay on Hebrew tradition, Aldous finds what he calls "caesura sentences" as the source of the "biblical" quality of some of Huxley's writings. Huxley employs this technique, in a great majority of cases, "when he wants to express himself in meditative aphorisms about the nature of life in general"(76).

Then, Aldous discusses Huxley's sparse use of images. Since, Huxley always aimed at accuracy and veracity in his works, he sparingly used images. Metaphors and similes help writers express their ideas very vividly, but since analogies are rarely complete, writers can achieve vividness only at the cost of precision. Hence, says Aldous, "seldom and only with great caution, does Huxley attempt anything like a full-blown simile" (77).

Lastly, Aldous claims that "Huxley's vocabulary is probably the weakest point in all his literary equipment" (78). Without elaborating, he concludes that Huxley's vocabulary is adequate but not exquisite. We miss in his writings "that studied alternation of words of Greek and Latin with words of Teutonic origin," which may bring about

the startling literary effects that Milton often accomplished in his writings (78).

Only partially agreeing with the claim that Huxley uses rhetoric, and refuting William Buckler's judgment that Huxley is only a "journeyman of high order," Joseph Gardener argues that Huxley's style is poetic, not rhetorical. Accepting the view that Huxley "does frequently use metaphor rhetorically" to illustrate and clarify, or to incite action, Gardener continues to say that Huxley uses metaphors poetically, too. Then, he argues that one of Huxley's essays, "The Physical Basis of Life," looked by some as a rhetorical achievement, is in reality poetic. He says that in this essay T.H. Huxley's metaphors play a primary role (They play a subservient role in rhetoric). The metaphor is the message--it is at once the vehicle and the meaning (in rhetoric it is used to illustrate or clarify something else). He concludes his explication by stating that many of Huxley's essays deserve such reading.

While some critics dwell upon Huxley's poetical or rhetorical use of language, others are drawn to Huxley's beautiful structural organization of essays. Calling his style a style of ideas and not of words or sentences, Chalmers Mitchell marvels at the architectural beauty of his compositions. The essays are built on the logical subordination of so many smaller ideas, where the smaller ideas fit into the whole like bricks fit into the construction of a house (215-16).

What is architectural to Mitchell is artistic to Blinderman. He looks at Huxley's essays as an artistic composition of ideas. A sense of form pervades all of his thinking and reveals itself in his organization. Huxley's Unpublished Papers, writes Blinderman, indicates that " a sense of structure pervaded his thinking" ("Theory of Aesthetics" 51). He says that this sense of form provides direction, unity, and structural integrity to Huxley's essays. This sense of imposing form on matter is born out of Huxley's conviction that the scientists and the artists are those "who arrest the flux of phenomena." Their attempt to "arrest the flux" is an attempt to order the apparent chaos around us in such a way that the flux becomes clear and comprehensible even to those who are not scientists or artists. Greater understanding of the nature around us, believed Huxley, helps mankind to be harmonized with it.

Hence, it becomes the duty of scientists to interpret nature and its forces for the lay people of the world. While attempting to do so, scientists or expositors confront the limited language facility of their audiences. This awareness helps expositors to translate the hieratic language of the experts into the common lay terms of their audiences.

Thus, to know all about their audiences before they attempt to popularize is the only way to success for communicators of scientific information. Analyzing audience and adapting to its background for successful communication

are emphasized from the days of Aristotle. Since then, writers have approached the subject from different perspectives. In the following chapter I shall review most of those perspectives to provide the necessary critical tools and a basis for analyzing Huxley's popular scientific prose.

CHAPTER II

BASICS FOR SUCCESSFUL COMMUNICATION:

AUDIENCE ANALYSIS AND ADAPTATION

Of the three elements in speech-making--speaker, subject, and person addressed--it is the last one, the hearer, that determines the speech's end and object.

Aristotle, Rhetoric, bk. 1: ch.3

To be a good writer you must know your audience--its purpose and its knowledge.

Thomas E. Pearsall, Audience Analysis for Technical Writing

Audience is an integral part of a communication process. Until a listener understands the message, the communication process is not complete. The message becomes meaningful, or the communication successful, only if there is an audience to receive and understand the message. Throughout this chapter I use the terms audience, listener, hearer, rhetor, speaker, and communicator to denote the essential elements of spoken communication situations, but the terms writer and reader to denote written communication situations. Also, I use audience throughout the dissertation to refer to listeners and readers.

In order to be successful, communicators need to be aware of the mechanism of the communication process as well as the ultimate destination of the process, the audiences. Their objective in the process is to get a desired response from their audiences. The response may be a favorable inclination to believe one theory against another, to see the rationality of a scientific concept or the irrationality of a superstitious belief, or simply to understand some issue of importance. Getting the desired response from the audiences depends on many factors such as the characteristics of the communicators, the usefulness of the message, the style of delivery, the choice of medium, and the background of the audiences.

Some of the factors are beyond the control of communicators. For instance, they may not have any freedom in choosing a medium for their message. They may be asked to make speeches when they would prefer to write. In an oral presentation, the background of the listeners or fortuitous factors such as the size of the presentation room and the time of the day may not be left to a speaker's choice. However, careful planners may at least anticipate these factors and minimize the problems they cause.

Some other factors, such as the style of delivery, are certainly under the control of communicators. They will endeavor to strengthen the factors by adapting their techniques of presentation to the background of their audiences. An awareness of the physical, educational,

psychological, and other aspects of their audiences help them devise suitable stylistic strategies, which may make the difference between failure and success. Therefore, awareness of and adaptation to the audience are vital to the success of any communicator.

As one of the great popularizers of the nineteenth century, was Huxley aware of the concept of audience analysis? Throughout his career, he addressed different types of audiences: experts in many fields of science; the general public consisting of the upper, middle, and lower class Victorians; and students of different age groups. Was he aware of the diverse background of his audiences? If he was, did he use his awareness to adapt the content of his essays? Did it affect his presentation techniques? Before analyzing Huxley's awareness of audience, I would like to discuss the concept of audience analysis and content adaptation in general, thus providing a theoretical and practical basis to evaluate Huxley's awareness of audience meaningfully.

Audience analysis is not a new concept. Though it has been emphasized from the time of Aristotle, it has been approached through three different perspectives. While the first perspective deals only with oral communication situation, the second and third perspectives take into account oral and written communication situations. The three perspectives differ from each other in their emphasis on audience. The first perspective deals only with the oral

audience, excluding it from the other parts of the communication process. The second perspective views the audience (both listeners and readers) in relation with the speakers or writers according to the communication situations. The third perspective looks at the audience (listeners and readers) in the context of the entire communication system; in other words, this type views the audience in relationship with the speakers or the writers and the other parts of the communication system. First, let me review the studies that treat audience as an exclusive concept.

Audience: Isolated Phenomenon

Aristotle, for instance, treats audience as neatly divided groups having generalized characteristics. He analyzes audience as an exclusive entity not related to any other component of a communication process.

Aristotle's Three Modes of Persuasion

Aristotle's three modes of persuasion are nothing but a rhetorical emphasis on audience analysis. These modes are the strategies adapted to the rational and emotional faculties of audiences. Aristotle's appeal to logos is an appeal to the rationality of audiences' minds. Rationality is an essential human characteristic. Audiences, however they may be swayed by a political creed, sect, etc., may still be influenced by speakers, if they carefully appeal to

those audiences' reasoning faculty. In his Rhetoric, Aristotle reminds rhetors that they should have faith in their listeners' intelligence and their attempts to order their lives on a rational basis.

Men are, Aristotle points out, as rational as they are irrational. Speakers have to deal with men as they are, not as they should be. Audiences will look upon speakers favorably if they know the speakers already. And in such cases, the speakers need to take advantage of their positive images in their audiences' minds.

Audiences, Aristotle says, are men of intellect and of will as well as of passion. The major portion of his Book II (chapters 2-11) deals with an analysis of audience emotions. "Emotions are all those feelings that so change men as to affect their judgments," says Aristotle (1380). He urges speakers to consider (1) the state of mind in which the emotion is felt, (2) the people toward whom it is felt, and (3) the grounds on which it is felt. He analyzes various emotions such as anger, calmness, friendship, and enmity through the three points of view. This type of analysis helps the speakers appeal to those emotions that would create a favorable atmosphere for them to persuade their audiences.

A Psychological Profile. The success of communication is almost insured once speakers identify and appeal to their audiences' emotions. However, these emotions are the

product of the physical, economic, and social influences on audiences. As early as the third century B.C. Aristotle taught speakers to analyze their audiences' characteristics in terms of their ages and economic and social classifications. What follows is an illustrative list of a psychological profile of various people based on their ages:

Characteristics of the Youth

- * Passionate and gratifies passion indiscriminately
- * Changeable and fickle
- * Possessed with keen but not deeply rooted impulses
- * Hot and quick tempered
- * Lovers of honor and victory rather than money ("not having yet learnt what it means to be without it")
- * Inclined to look at good side rather than bad side
- * Capable of trusting others readily

Characteristics of the Elderly

- * Cynical
- * Capable of neither warm love nor bitter hate
- * Distrustful
- * Small-minded (in the sense humbled by life)
- * Having practical desires
- * Not generous
- * Cowardly
- * Living by memory rather than by hope

Characteristics of Men in Their Prime

- * Between that of the young and that of the old, free from the extremes of either

- * Not excessively confident, nor too much timid
- * Neither parsimonious nor prodigal
- * Brave and temperate

He gives us neatly divided and generalized characteristics of the three types of audiences based on their ages. Also, he talks about audiences' characteristics in terms of good birth, wealth, and power. He emphasizes the need for speakers to analyze and adapt to audiences: "People always think well of speeches adapted to, and reflecting, their own character: and we can now see how to compose our speeches so as to adapt both them and ourselves to our audience" (1406). As Edward Corbett says, Aristotle's audience analysis "was the beginning of the science of human psychology" (35). The speakers need for sketching a psychological profile of their audiences is emphasized from the beginning of rhetorical studies.

Cicero's Emphasis on Emotions

Following Aristotle, Cicero too emphasized an awareness of audience for successful communication. In his De Oratore, he characterized a successful rhetor as one who is acute, clever, intelligent, and a keen observer of the thoughts, feelings, opinions and expectations of his fellow-citizens (223; bk. 1).

Of the audiences' thoughts, feelings, and other aspects, Cicero lays emphasis on tuning to their feelings. M.L. Clarke points out that "Cicero is indeed less

interested in the appeal to the head than in that to the heart." (51). In his book, Cicero claims that men are often influenced by hatred, love, desire, anger, grief, joy, hope, fear, misconception or some other emotion in making judgments than by truth, the principles of justice, the procedure of the courts, or the laws (178; bk. 2). Hence, he emphasizes specifically the rhetorical appeal to emotion, success in which, he holds, constitutes the chief excellence of orators.

George Campbell's New Insight

Coming at the end of the long tradition of rhetoric, Hugh Blair, George Campbell, and Richard Whately, initiated, as James Golden and Corbett point out, the period of modern or new rhetoric in the eighteenth century (1). The various rhetoricians who came before and after this period continued to emphasize the awareness of audience and their characteristics for successful communication.

Golden and Corbett observe, "The psychological-philosophical theory of human communication behavior significantly influenced the principles of Campbell, and to a lesser degree, those of Blair and Whately" (15). A review of Campbell's audience analysis is, therefore, representative enough to show how he and, thus, others influential in rhetoric in the eighteenth century, differ from their predecessors in this matter. He discusses in two chapters the speakers' need for audience analysis.

Analyzing Audience's Mind. If Aristotle's conception of audience and his analysis of its characteristics are based more on human emotions, Campbell's analysis is based more on the functioning of human mind. However, he does not neglect the study of human emotions. In The Philosophy of Rhetoric, he tells speakers that humans are endowed with understanding, imagination, memory, and passion; and successful communication depends on the degree to which they engage their audiences at these four levels (205-224).

First, speakers should consider their audiences as men "endowed with understanding." Understanding depends on "the capacity of education and attainments of hearers." Campbell goes beyond stating this oft repeated fact when he links the faculty of understanding to two specific areas of communication: nature of content and expression. If speakers fail to communicate to their audiences' understanding, the cause, he asserts, must be either "in the sense or in the expression." If the ideas introduced are entirely "out of their sphere of knowledge" or too abstract for "their apprehension and habits of thinking," or if the train of reasoning be longer, more complex, or more intricate than "they are accustomed to" the audience will not understand.

Second, audiences are men "endowed with imagination." Effective speakers must engage the imagination of their audiences by conveying ideas with vivacity, beauty, sublimity, and or novelty. Lively expressions not only

please audiences, but command and preserve their attention and induce them to believe in the ideas conveyed.

Third, speakers must consider their audiences as "endowed with memory." They will retain the ideas engaging their imagination more readily than languid ideas. Orderly composition of a subject, figures of speech, rhetorical repetitions, transition, and recapitulations are some of the methods speakers need to use to help their audiences' retention of subject matter.

Fourth, speakers should treat their audiences as men "endowed with passions." "When persuasion is the end," says Campbell, "passion also must be engaged. If it is fancy which bestows brilliancy on our ideas, if it is memory which gives them stability, passion doth more, it animates them. Hence they derive spirit and energy" (210).

Campbell argues that it is not possible for speakers to persuade without speaking to audiences' passions. Even the "coolest reasoner always in persuading addresseth himself to the passions some way or other" (210). He tells orators to follow two strategies in persuading audience: First, excite some desire or passion in the hearers. Second, demonstrate that the gratification of their desire or passion depends on carrying out the action to which the orators would persuade them. Campbell points out that "if the hearers are judicious," speakers should carefully plan to achieve both the ends, the pathetic as well as the rational. If "the hearers are rude and ignorant," it is adequate for the

speakers to inflame their passions to achieve their ends. Then, he discusses a series of circumstances that are chiefly instrumental in operating on their passions.

Perceiving the Audiences' Heterogeneity. The principles of human understanding, imagination, memory, and emotions are common to a whole group; however, the intensity and degrees of engagement of these factors vary from individual to individual within the group. Therefore, speakers have to keep in mind the individuality of each one of the audience in the group.

Unlike his predecessors, Campbell brings a new impetus to the concept of audience analysis. His predecessors were treating audience as a single group with a homogeneous background. For instance, Aristotle analyzed audiences by putting them in neatly divided groups of the young, the old, and the prime aged. Campbell realized the flaw in such neat but unrealistic classification and stressed the need for looking at audiences in a different perspective: "The hearers must be considered in a two fold view, as men in general, and as such men in particular" (205).

Campbell tells a speaker that he needs to consider "the special character of the audience, as composed of such individuals: that he may suit himself to them both in his style and in his arguments" (223). He reminds him that the individuals in a group may differ in their capacity for understanding and manner of life, which will reflect upon

their imagination and memory. Even if the differences in education and moral culture are not considerable, the individuals may differ from each other by their occupations and habits. Therefore, stresses Campbell, the speaker must take into consideration the infinitely diversified characters of audiences and the demands that they may have upon the speaker.

Audience: Participant in the Communication Process

In relation to Aristotle and Cicero, Campbell's audience analysis focuses more on the complexity of analyzing an audience and on the speaker's need for addressing the four levels of human mind. His audience analysis is an activity that speakers need to consider well before the communication process can take place. However, writers like Otis Baskin and Sam Bruno consider analyzing audience during the communication process. Also, while Campbell analyzes audience as an isolated component of a communication situation, Baskin and Bruno stress the necessity for analyzing audiences--how their minds work--in relation to their speakers.

Baskin and Bruno's Transactional Analysis

Baskin and Bruno's study characterizes communication as a transactional process. It is a process involving the

simultaneous participation of both speakers and listeners. According to them, during a communication process, an audience keeps sending out many responses and cues, which are signals that help speakers adapt their speeches to suit the situation. If they are alert, they get such vital signals in large number during the communication process (65-73).

The transactional analysis views both senders and receivers as inseparable units of the communication process. The senders as well as the receivers are too complex to define clearly. Each individual is the product of his own total life experience, which helps him interpret new situations. These experiences influence behavior as well as responses (encoding, decoding processes) in a given situation.

How does the transactional system function? According to Eric Berne, the human psychological system is subdivided into three ego states: the "Parent" or "exteropsyche," the "Adult" or "neopsyche," and the "Child" or "archaeopsyche." The Parent system is judgmental in nature. It tries to impose a set of rigid standards that have been borrowed from one or more parental figure in the past. The Adult system interprets information in an objective, rational manner and is primarily concerned with reality testing. The Child system consists of a set of feelings, attitudes, and behavior patterns that are relics of the individual's own childhood (75-79).

The following visual represents the psychological system of a sender and a receiver in a communication process:

Context of Time, Space, and Occasion

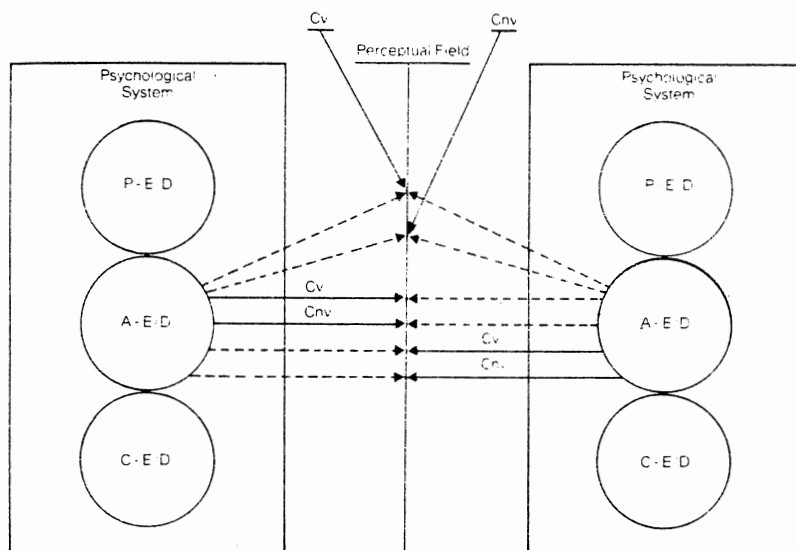


Fig. 1. A Transactional Systems Model of Communication, Baskin and Bruno, Journal of Business Communication 15 (1977): 69.

P-E/D: Parent Encoder/Decoder System

A-E/D: Adult Encoder/Decoder System

C-E/D: Child Encoder/Decoder System

Cv: Verbal Cues

Cnv: Nonverbal Cues

---> Transmission

...> Perception

Through this system, an individual encodes and decodes stimuli in a prelogical manner with poorly differentiated or distorted perceptions. For example, a person faced with a new situation may react in any of the following manners: The Child system of the person may respond emotionally (fear, embarrassment, etc.). This response is an immediate one. Then, the Parent system judges the situation; it tries to resolve the feelings experienced by the Child system as right or wrong. The Adult system, however, rationally weighs the benefits and detriments derived from the situation. Thus, individuals select a perception depending upon their personality system.

The personality system not only decodes stimuli but also selects the stimuli from the Perceptual Field. The Perceptual Field may be a picture viewed by one, or scenery shared by many, or a presentation made to a group. According to Berne, there are basically two types of transactions: complementary and crossed. In complementary transaction the sender and the receiver transmit cues on the same level as shown in the figure above. On the other hand, if the sender transmits and perceives cues at the Adult level whereas the receiver transmits and perceives cues at the Child level, the transactions cross and the communication breaks down. Thus, a knowledge of the mechanism of the communication process helps speakers look for and interpret the various cues receivers may provide from time to time and thereby avert communication breakdown

(75-79).

Norma Carr-Smith: Perceiving Audience's

Defensive Barriers

A knowledge of the transactional nature of communication, says Norma Carr-Smith, would help speakers overcome defensive barriers. A defensive barrier is an unconscious disapproval sign from an audience, which may have been caused by many factors. For instance, when speakers communicate that they think they are superior in some way, such as by position, power, or wealth, audiences are put on the defensive. In such circumstances, a speaker must establish, according to Carr-Smith, "an Adult-Adult transaction and . . . communicate trust and respect for the receiver" (14). This kind of act is especially supportive and will reduce defensive reactions by establishing an atmosphere of equality would help speakers achieve their objectives. The awareness of defensive barriers is possible only when speakers are alert to analyze audiences' responses while the communication process is taking place.

Baskin, Bruno, and Carr-Smith analyze audience in a situation that is bound by time and space. Most of their discussion of audience analysis focuses on an audience whom speakers can see and actually interact with. However, often communication extends beyond the temporal and spacial boundaries, when writers communicate with audiences whom they cannot see. For instance, audiences of printing as

well as broadcasting media are often distanced and unknown to communicators. The relationship between them becomes more complex. Writers like Walter Ong and David Carson focus on this faceless audience and the problems writers have in analyzing such an audience.

Walter Ong: Fictitious Audience

The faceless audience, according to Walter Ong, is always a fiction. It lives only in the minds of writers. It takes shape, life, and personality in the writers' imagination only. Ong says that even if writers know their readers personally, they have to imagine an audience when they write. According to Ong, whether writers be historians, scholars, letter writers, or scientists, they always fictionalize their audiences, "casting them in a made-up role and calling on them to play the role assigned" (17).

Thus, for Ong, the writer-reader relationship is fictive rather than factual because writing is a lonely activity. While writing, irrespective of time, space, or subject matter, writers are withdrawn into their own world with the fictionalized audiences. They construct in their imagination audiences "cast in some sort of role." The audiences may be entertainment seekers, reflective sharers of experience, or some other people who are expected to play roles in which the authors have cast them. But these roles "seldom coincide with [their roles] in the rest of actual

life." The source of the audience that writers fictionalize is not daily life, but, as Ong suggests, other authors, "who were fictionalizing in their imagination audiences they had learned to know in still earlier writers, and so on back to the dawn of written narrative" (17).

While reviewing the history of readers' roles, Ong points to the journalistic practice of Addison and Steele in the eighteenth century and the new writer-reader relationship they developed. Addison and Steele assumed "a fashionable intimacy" between readers and writers (14). They achieved this intimacy by casting readers and writers themselves in the roles of coffee house habitués. From earlier journalism, says Ong, this intimacy caught on in the world of sports writers, war correspondents and other writers as well (14).

Awareness of audience in the fictitious relationship becomes problematic to writers, especially inexperienced ones. Since the audience is a fiction, the inexperienced writer often creates the audience in the writer's own image. The real reader is then required to "play the role in which the author has cast him" (15).

David Carson: Complications of the Fictitious Relationship

The complex writer-reader relationship creates, says David Carson, a problem for writers. Their audience constructs become hazy because their audiences are

imaginary. Without any source for guiding them in ascertaining the characteristics of a particular audience, writers often rely on their intuition to create the necessary audience constructs from an imaginary universal audience. Because there is very little chance for feedback from this audience, their audience constructs remain hazy. Referring to Chaim Perelman, Wayne Booth, and Walter Ong, Carson asserts that even when a writer knows his audience personally, "the image of audience which the writer carries in his or her mind is merely a fictive construction based upon available data" (25).

Audience: An Aspect of the Communication Situation

In recent years, the concept of audience analysis has drawn lot of critical attention. While recognizing the richness and complexity of this subject, many critics are increasingly dissatisfied with traditional audience analysis because it is too limited for them.¹ It works only for persuasive discourses and seems inadequate to analyze discourse situations with general audiences.

Analyzing audience, then, depends on situations. Lisa Ede points out that audience is an inherently situational concept (294 ff.). Therefore, analyzing audience involves describing the situations. The situation may be rhetorical, where a speaker tries to persuade his audience; a professional group meeting, where a speaker shares his ideas

with his colleagues; a general public address, where a speaker communicates new information, or any type of writing situation.

Douglas Park propounds "a general framework" that accommodates the different possible communication situations (484-85). How does this framework function? First, to understand the audience in any situation, a writer needs to recognize the identity of the audience, which is, of course, the foundation of audience analysis. An audience exists when there is an established social institution or social relationship. Hence, the writer needs to find out the institution or social relationship which his discourse will serve or create.

Second, the writer needs to analyze the function of the discourse in that relationship. As speech-act theory and sociolinguistics in general suggest, we need to see all discourse as representing action performed within and conditioned by social situation.

Third, the writer needs to be aware of the physical setting in which, or the means of distribution through which, he would deliver the discourse to the audience. For an audience to assemble, there must be a physical setting. For written discourse, the physical setting is a means of publication or any other distribution system. He has to understand the conventions and the formats associated with the physical setting or the means of distribution.

Fourth, the writer needs to analyze his audience's view

of the subject matter and the intentions of the discourse. This analysis would help him to recognize the knowledge and attitude of the audience that would affect the purpose of the discourse. Also, the writer needs to recognize the collective identity of the audience. If a majority of the audience possesses a dominant attitude, it may affect the subject and the purpose of the discourse.

The kind of attention a writer pays to these details may vary significantly based on the situations. A discourse addressed to an institution or written to a scholarly periodical, for instance, aims exclusively at well defined members of the institution or periodical, and the audience significantly influences the discourse in the situation by responding to the discourse. This kind of discourse, which is transactional in nature, needs great attention on the part of the speaker or the writer. The discourse written to a general audience, by contrast, does not aim at any specific type of audience. Hence, understanding the identity becomes a matter of understanding the readers' expectations, the nature of subject discussed, and the conventions that govern that kind of prose--particularly understanding the setting of publication that uses those conventions to a specific format or to a set of assumed interests and attitudes in readers.

Audience: From Analysis to Adaptation

Like Park and others, Theodore Clevenger too finds

traditional analysis too limited. He considers the analysis of audience taken out of the entire communication framework as too simplistic. He includes all such attempts under two modes of analysis: demographic analysis and purpose-oriented analysis. Proposed first by Aristotle, demographic analysis lists the demographic characteristics of audience such as age, sex, income, marital status, and political party preference in general. This analysis presumes that these characteristics tend to make an audience susceptible to some arguments and ideas and less responsive to others. On the other hand, purpose-oriented analysis emphasizes the speakers' need to understand their audiences' knowledge and experience in the context of a given communication situation. For example, to address a professional body, speakers may be interested in knowing only the audience's knowledge about a subject rather than its age and sex.

Theodore Clevenger: Adapting Content and Style

Looking beyond the traditional concept of audience analysis, Clevenger moves toward content and stylistic adaptation. Superficially the term audience analysis seems to focus on audience only. However, this is not true. The standard communication formula for success is who says what to whom, when, and how, with what effect. Hence, speakers cannot ignore the five elements when they are working primarily on only one element. They must consider all the

elements together, taking into account all of them simultaneously. Each element, Clevenger declares, "relates to all of the others in the total pattern so that to view any one element in isolation leads to distortion because it leads to over simplification" (25).

This analysis does not end within itself. It leads to the following strategic components of a speaker's planning stage: 1. audience selection, 2. message planning, 3. message pretesting, 4. monitoring of effects. Clevenger discusses message pretesting and monitoring of effects in the twentieth-century context of marketing technique and consumer persuasion. I will include in the review only the first two factors that have direct relation to the context of nineteenth-century popularization.

Some speakers have the choice of selecting their audiences. If a speaker's purpose is to get the audiences to approve a new idea, he may first speak to people "who are more likely to be favorable or open-minded" toward his idea. By addressing a selected audience, he economizes his efforts to achieve possible success. Moreover, he reduces the likelihood of mobilizing an opposition. Depending upon the idea, says Clevenger, the speaker may consider it wise to address his initial efforts to "the young, the rich, the well-educated, the cosmopolitan, the aspiring, the disenchanting, the desperate, or whatever other group he judges most likely to offer fertile ground for his idea" (33).

A speaker has to plan the message and make some choices based on audience analysis--1. selecting topic 2. formulating specific purpose 3. laying out major lines of development, 4. selecting supporting details, and 5. choosing language. Audience analysis serves both "a creative and a critical function" in message planning. As far as selecting topic, purpose, illustration, etc., the analysis helps a speaker be creative. And in the case of choice among alternatives--between two topics, purposes, visuals, etc.--it provides him with necessary critical judgment.

Myron White: Content and
Language Selection

Recognizing the limitations of traditional audience analysis, Clevenger moves toward content and stylistic adaptation. Similarly, recognizing the limitations of contemporary books in dealing with the concept of content adaptation, Myron White points out that in contemporary books, there is no specific discussion about "how particular, or special, audiences can affect the content of writing as well as its expression" (6). In other words, what is the relationship between readers and the content and language of whatever they read?

Even the few books that deal with the adaptation concept do not discuss in what areas of communication, in what aspects of the speech or written form, the speaker or

the writer should make changes. Nor do they present the types of changes that should be made. White reminds writers that "keeping an audience in mind includes two major concerns: selecting a content which will meet its informational requirements and choosing language to suit its background" (7). The analysis, thus, does not end with the audience's characteristics, but extends to the two specific areas of writing: content and language. White points to the general problem of the books that customarily deal with the topic. However, other than pointing out that we need to adapt the content and language, he has not discussed how a writer can make this adaptation.

Thomas Pearsall and Kenneth Houp:
Combining Traditional Analysis with
Content and Stylistic Adaptations

Kenneth Houp and Thomas Pearsall discuss in detail the aspects of adaptation that White lamented for its absence in most of the traditional books on audience analysis. Combining the traditional discussion of audience analysis with a purposeful content and stylistic adaptation, Houp and Pearsall focus their attention on the readers' background and adaptation:

You must know who your readers are, what they already know, and what they don't know. You must know what your readers will understand without explanation and without definitions. You must

know what information you must elaborate, perhaps with simple analogies. You must know when you can use a specialized word and when you cannot. You must know when to define a specialized word that you can't avoid using. (20)

Fundamental to the awareness of and adaptation to audience is the writers' understanding that "readers bring their experience and their experience only to their reading" (20).

In order to devise adaptive techniques, writers have to fully understand diverse groups of audiences and their unique spectrum of characteristics. Houp and Pearsall look into this complex mass of audiences and divides them into five meaningful categories: laymen, executives, experts, technicians, and experts. At the outset, they remind us that "no audience is uniformed, falling readily into a neat category" (21), and that the audience is highly heterogeneous like "an aggregate of rocks of all shapes and sizes as opposed to a mass of smooth marbles" (21). However, the five categories help writers achieve meaningful insight into the composition of a particular audience and thereby have a great control over the communication process.

Having divided the audience into five categories, Houp and Pearsall then discuss various adaptive techniques such as background information, analogy, visuals, sentence length and variety, and other stylistic devices. I will review in the following pages their adaptive techniques for lay audiences only; these techniques are directly related to my

thesis, for scientific popularizing focuses mostly on this audience. Also, I restrict my attention to only those stylistic devices that Huxley has used in his scientific prose--human element, analogy, common examples, etc.

Lay audiences are the most challenging to address because it is very difficult to define them. Laymen present, says Pearsall, "a bewildering complexity of interests, skills, educational levels, and prejudices" (Audience Analysis for Technical Writing xii). Their educational background may vary from high school to college degrees. Pearsall defines them as audiences who read outside of their own particular fields of specialization. Whatever they read, they read for general interest and want to understand the world around them. This interest is mostly personal, stemming from some practical requirements. Whatever writers write, the content has to be reader-oriented.

In order to capture the lay audience's attention, say Houp and Pearsall, motivate its interest, and convey the message clearly, writers need to adopt various strategies such as using human interest, background, definitions, and simplicity. First, human interest and human drama motivate lay people, for they are interested in other human beings and human personality. To gain acceptability for their subject matter, writers need to use this technique, irrespective of the complexity of subject matter. However, Houp and Pearsall caution writers that this technique should

not be used to exaggerate scientific achievement or forego content accuracy.

Second, to comprehend a subject, lay people need background information, which prepares them to understand the subject matter well. In providing background, writers may often use analogy, which is "a powerful device to help the lay readers" (25). Houp and Pearsall suggest that writers use imagination to pick up the innumerable simple things that are familiar to lay people and use them to make the readers' task of understanding the subject easier.

Third, defining specialized words is a courtesy extended to readers. Writers' attitude toward readers need to be that of a host toward a guest. They have invited readers to their prose, and it is a discourtesy to use a language that is foreign to them. Writers are proficient in language in two levels: expert language that they share with a small group and common language that they share with others. It is rude on the part of the writers to use expert language when they communicate with lay people. It is an act of indifference to the guests. Therefore, writers need to define specialized terms in familiar words. However, Houp and Pearsall caution, writers should take care not to distort or sensationalize the true meaning, which is a disservice both to experts and lay people.

Finally, writing needs to be simple both in conveying ideas and handling language. Writers can convey ideas through mathematics, formulas, and diagrams, but they are

shorter expressions for expert audience and often incomprehensible to lay people. Therefore, writers need to convey ideas in plain language.

Audience Analysis is an Art

The very act of audience analysis is an art for Clevenger. An audience is always composed of individual auditors. An auditor "brings much more than some imaginary and universal 'listening faculty' to the communication setting; he enters the setting as an individual whole and entire, bringing the residue of his whole life's experience with him" (8). He is not a "passive" listener. Many thoughts are crisscrossing in his mind at the very minute a speaker is addressing him.

An audience is a complex group. Its understanding of, interpretation of, and responses to a message vary depending upon many different variables. Communicators cannot apply any standard or common rule to judge how an audience will respond in a given communication situation, but they can judge the characteristics and responses of a given group by their own education and experience.

Like an artist who sees and selects bits and pieces out of the flux to create his work, a communicator needs to look for the favorable characteristics and responses that are already there in the audience so that he can combine those qualities into an effective presentation. The better educated and more experienced the communicator is, the

keener is his insight into the audience composition and the better is his presentation.

So much for the philosophy of audience analysis. Many communicators throughout the history of mankind have effectively practiced this philosophy, including Thomas Henry Huxley, who wrote to diverse groups of audiences quite successfully. In the following chapters, I will discuss his awareness of audience and adaptation.

Note

¹ See, for instance, Barry Kroll, "Writing for Readers: Three Perspectives on Audience," CCC, 35 [May,1984], 172-75; Russell Long, "Writer-Audience Relationships," CCC, 31 [May,1980], 221-26; and Arthur Walzer, "Articles from the 'California Divorce Project': A Case Study of the Concept of Audience," CCC, 36 [May,1985], 155-58.

CHAPTER III

HUXLEY'S AWARENESS OF AUDIENCE

The prince of scientific expositors, Faraday, was once asked, "How much may a popular lecturer suppose his audience knows?" He replied emphatically, "Nothing."

-T.H. Huxley, Life and Letters

Popularizers need to be aware of their audiences' knowledge of a subject matter in order to adapt the content of the subject to the audiences' educational background. While the demographic analysis provides the popularizers with a general background of their audiences, the purpose-oriented analysis helps them to investigate the specific background of their audiences that is directly related to the subject they are presenting.¹ Such an analysis is the basis for their content and stylistic adaptation. Was Huxley aware of his audiences? If so, how much of his audiences' background did he know?

Awareness of Audiences'

General Background

This chapter is a profile of Huxley's audiences as he analyzed them. The profile is composed of general as well

as specific characteristics of his audiences. For example, Huxley was aware of his audiences' general educational and social background. Also, he was aware of some of their specific characteristics such as their familiarity and unfamiliarity of a particular subject. I shall begin the discussion with his own account of his awareness of the audiences that he addressed from time to time.

Awareness of Audience

The concept of audience awareness was in Huxley's mind from his first address. (I use address, lecture, and essay in a general sense, referring to Huxley's addresses and lectures published in his Collected Essays. As I mentioned in the preface, I do not treat his "addresses" separately from his "essays," for there is no record, if any, available to me about the changes Huxley had made from the speeches to essays when he published them.) He made his first popular lecture "Upon Animal Individuality" in 1852 at the Royal Institution in London. The Institution audience comprised, says G. W. Smalley, who attended Huxley's addresses to the Royal Institution in the seventies and early eighties, "the celebrities of science and the ornaments of London drawing-rooms" (L. Huxley 2: 440). Huxley's personal letters, written at the time of such presentations, show that he was indeed aware of the audience.

In a letter written to his sister Elizabeth, Huxley provided some details about the celebrities: "There was a

very good audience--Faraday, Prof. Forbes, Dr. Forbes, Wharton Jones, and [a] whole lot of 'nobs' among my auditors" (L. Huxley 1: 108). Professor Edward Forbes was a leading zoologist, who encouraged Huxley to enter the world of science. Dr. James was a scientist known for his glacier theory. Wharton Jones was Huxley's physiology teacher at the Charing Cross School of Medicine, whose teaching he admired very much.

In another letter to his sister, Huxley wrote, "It was the first lecture I had ever given in my life, and to what is considered the best audience in London." (L. Huxley 1: 106). His confidence to face any other audience was built up after the first address and he declared in the same letter: "After the Royal Institution there is no audience I shall ever fear" (L. Huxley 1: 107). Though Huxley would not have to "fear" any audience, he was conscious of the audience whenever he made presentations.

In 1881, Huxley addressed the International Congress of Medicine in London. A letter, written to his wife two days before the address, reflects his preoccupation with the expert audience of the Congress:

I have been toiling at my address this morning. It is all printed, but I must turn it inside out, and make a speech of it if I am to make any impression on the audience in St. James' Hall. (L. Huxley 2: 36)

Thus, these letters prove that Huxley was conscious of his

audiences.

Besides these letters, Huxley's consciousness of audience comes through the pages of his essays. Sometimes he makes explicit remarks about the nature of the audience he is addressing, but sometimes the sense of the audience comes through the content adaptation (I will discuss this aspect in the next chapter). The explicit or implicit remarks clearly demonstrate his awareness of audience.

Awareness of Diversity of Audiences

All through his life, Huxley lectured specialists, laymen, and students. His expert audiences comprised the members of the Royal Society, the Linnaean Society, the Zoological Society, and other professional bodies. The laymen included the sophisticated, fashionable, upper class intelligentsia of the Royal Institution and the various philosophical institutes, the middle class audiences of the British Association for the Advancement of Science, and the artisan class. The students included both college and school students. How do we know that Huxley was aware of these people? How much was he aware of the differences among them? Has he made any explicit comments of his awareness in the texts? Outside of the texts?

Huxley was aware of the diversity of the audiences he addressed over many years. Referring to the difficulty of avoiding repetitions of ideas in his essays that were published in one volume, Huxley said, "It would hardly be

otherwise with speeches and essays, on the same topic, addressed at intervals, during more than thirty years, to widely distant and different hearers and readers"

("Preface," Collected Essays, Vol. 3). The "Preface" he wrote to his Collected Essays, Vol. 8, reiterates his awareness of his audiences' diversity. This volume consists of popular addresses like "On a Piece of Chalk," delivered to the working men of Norwich, and the three Presidential addresses he delivered to the Geological Society. His sense of the distinction between the two types of audiences had prompted him to announce to his readers about the collection of essays: "The contents of the present volume . . . are either popular lectures, or addresses delivered to scientific bodies with which I have been officially connected" (v). Not only was he aware of the differences among his audiences in terms of their expertise and professional affiliation, but also he recognized the geographical and temporal distance that separated his audiences.

Awareness of Geographical and Temporal Differences

Huxley addressed the Edinburgh Philosophical Institution in 1868 on the similar protoplasmic basis of plants and animals and repudiated the claim that this scientific discovery was materialistic. In that address he incorporated references of local interest and of familiarity

only to the Edinburgh audience. The day before he made his speech, the Archbishop of York, Thompson, delivered to the same audience a lecture on the limitations of modern scientific spirit. This address was reported in the local newspaper. Huxley saw this paper, read the report, and refuted the Archbishop when he addressed the audience the next day. But when he published the essay in his Collected Essays, Vol. 1, in 1893, he dropped the references he used from the newspaper report. In a footnote to the essay he said, "Some phrases, which could possess a transitory and local interest[,] have been omitted" (130). Instead, he incorporated references from the Archbishop's pamphlet On the Limits of Philosophical Inquiry, which was published subsequently. Why did he change the references?

First, Huxley knew that some phrases of "local interest" would be eagerly received by and made sense only to the Edinburgh audience. Second, such "transitory" phrases do not have much significance to an audience of his Collected Essays who are geographically as well as temporally distanced from the Edinburgh audience. So much for the general background awareness. How much of his audiences' specific background that is related directly to the topics of his addresses did Huxley know?

Awareness of Audiences' Specific

Background

Huxley had made many references explicitly or

implicitly in his addresses that reflect his understanding of his audiences' specific background relevant to his addresses. He made specific references to the expertise of the audiences he was addressing; he referred to the ignorance of his lay audiences toward Darwinism; and he was aware of their religious beliefs, their ages, and their love of sports. I shall discuss his awareness of his audiences' specific characteristics in the following pages.

Recognizing Audiences' Professional

Identity

Huxley addressed the Geological Society on three occasions, once in behalf of the President of the Society when he was the Secretary of the Society and twice as the President of the Society. In his first lecture, "Geological Contemporaneity and Persistent Types of Life," he indicates the speciality of the experts. Referring to the development of geological science, he tells the audience that "your favorite science has her own great aims independent of all others" (CE 8: 273). Likewise, in his second address to the Geological Society, "Geological Reform," he directly refers to the profession of his audience. Referring to a matter that was of the utmost concern to the audience, he says, "It is surely a matter of paramount importance for the British geologists . . . here in solumn annual session assembled . . ." (CE 8: 305-06). His explicit remarks in these addresses reveal his awareness of the identity of his

audiences.

Huxley considered the society as an exclusive body of scientists. When his contemporaries proposed that students should be included in the society, Huxley opposed any such move. In a letter to Sir Charles Lyell, the British geologist, he expressed this view: "The Geological Society is not, to my mind, a place of education for students, but a place of discussion of adepts" (L. Huxley 1: 228). A professional society serves as a link between the members, who have similar interest, goals, and objectives. For Huxley, the primary and the most important object of a professional society was to provide the scientists with a platform for learned discussions. To include students, in his view, would prevent any discussion of complex, technical matters.

In addition to the Geological Society, Huxley addressed many other professional bodies such as the International Congress of Medicine. In "The Connection of the Biological Sciences with Medicine," Huxley makes a direct reference to the special interest of the group. Proposing to reveal the connection between biological sciences and medicine, Huxley asserts that the topic would be of much interest to "the members of this great Congress, profoundly interested as all are in the scientific development of medicine" (CE 3: 350). Thus, Huxley's recognition of the professional group comes through in his addresses to expert audiences.

Huxley would not have had any difficulty in recognizing

the professional affiliation of the members of the Geological Society, but what about his lay audience, who did not belong to any scientific or professional groups? How did he recognize this audience? Answers to these questions lie in his various addresses to the artisan class. Huxley devoted much of his time imparting scientific knowledge to this class, for he believed that only such knowledge could alleviate their sufferings. His desire for improving the working men's lives through scientific knowledge resulted in his working men's addresses.

Since his early days, Huxley had been watching the social, economic, and educational backwardness of the artisan class. This awareness helped him to adapt his lectures effectively for this audience. Huxley delivered the "Six Lectures to the Working Men" in 1862, and when he printed the lectures in 1893, he recollected the nature of both the subject and the audience as "the ABC of the great biological problem as it was set before a body of shrewd artisans at that remote epoch" (CE 2: vii). How much of the shrewd artisan was he aware of when he presented the lectures in 1862?

Direct and indirect references in the lectures reveal Huxley's knowledge of the background of the artisans he was addressing. Though he wanted to discuss Nature and Darwinism, he told them in the beginning of his first lecture, "I have no right to suppose that all or any of you are naturalists" (CE 2: 304). This remark reveals that he

knew that the audience did not belong to any specialist group. His remarks in the second lecture point to the lay background of the audience. They are not paleontologists, so they do not know the differences between fossilised animals and the present day forms. Referring to the two groups of animals, Huxley states, "I doubt very much whether your uninstructed eyes would lead you to see any vast or wonderful difference between the two" (CE 2: 353). Thus, Huxley's remarks in his essays point to his recognition of the general identity of his audiences.

Recognizing Background Knowledge of Subject

Huxley's recognition functions at the demographic as well as purpose-oriented levels. On the demographic level, he identifies his audiences as members of various professional bodies, philosophical institutes, or general audiences. Sometimes, he sees them as members of different social classes: He refers to them as "dilettante middle class" and "working class men." On the purpose-oriented level, he analyzes his audiences' background closely, keeping in mind the subject he is going to deliver to them. At this level, irrespective of their social or professional identifications, Huxley analyzes them for their knowledge about the subject, their attitude toward it, and their religious beliefs related to the subject.

In his working men lectures, Huxley expostulated

Darwinism. How much did he know about the workers' knowledge of Darwin's Origin? Referring to the book, he tells them in the beginning of his first lecture,

That work, I doubt not, many of you have read; for I know the inquiring spirit which is rife among you. At any rate, all of you will have heard of it,--some by one kind of report and some by another kind of report; the attention of all and the curiosity of all have been probably more or less excited on the subject of that work. (CE 2: 303-04)

Huxley was aware of the heterogeneity of the audience he was addressing. As Campbell suggested, the audience is a group as well as a group composed of individuals (205). As Houp and Pearsall point out, it is an "aggregate of rocks" of diverse shapes and sizes (21). The speakers need to look at the audience as a group and analyze the group characteristics. At the same time, they need to keep in mind the individuality of each member of the group. While analysis of the group may provide speakers with general background information such as educational level, the awareness of the individuality of each member of the group will help them to remember the demands each individual may have on the speakers. He was sure that some of his hearers had read the Origin themselves and others had at least heard about the book.

The work of Darwin created a lot of curiosity in

people. As Chalmers Mitchell recalls, "The newspapers and the reviews were full of the new subject; political speeches and sermons were filled with allusions to it" (119). In the scientific community, Lyell, Tyndall, Hooker, and others supported the new evolution theory while the leading paleontologist Sir Owen opposed it. Anonymously he wrote a severely critical review of Darwinism in the Edinburgh Review. Helped by Owen, the influential Bishop Wilberforce criticized the theory in the Quarterly Review². Huxley himself reviewed the theory favorably in the Times. As Huxley rightly assumed, the workers had heard of this subject and the work. He proceeded to expostulate Darwin's work based on this assumption.

Huxley makes a reference in the course of his lecture showing that he was not only aware of the educational level of his audience, but also adapted his speech according to the situation. To show the workers the viscera of a horse, he uses a visual of a horse, beneath which is written the Latin phrase Equus caballus. Do the workers know Latin? Huxley answers the implied question: "You need not bother yourselves with this "Equus caballus" written under it; that is only the Latin name of it, and does not make it any better. It simply means the common horse" (CE 2: 306).

Huxley might have easily assumed that workers have no knowledge of Latin or anything about Darwinism. But what about expert audiences? Can a communicator assume that they know all about the subject? Does he need to be aware of

anything specific about their background knowledge of the subject?

In his address "On Geological Reform," Huxley took up one of the burning questions of geologists: What had been once the land is under the sea now and what had been once the bottom of the mighty oceans had risen to form the land surface. The surface of the earth is marked by cliffs and valleys. What are the causes of these geological changes? As Chalmers Mitchell explains, on one hand the older school of geologists argued that a series of mighty catastrophes had caused these geological changes. On the other hand, geologists like James Hutton and Charles Lyell advocated a doctrine of uniformitarianism, attributing these changes to the slow and continual forces of wind and water for very many centuries (80-81).

Hutton wrote about this theory in 1795 in his incomplete The Theory of the Earth. This work and Lyell's Principles of Geology (1830-33) accounted for the progress in geological thought in the century. Huxley believed that geologists could not separate their debts to Hutton from their obligations to Lyell for the geological progress. However, between Hutton and Lyell, the audiences, Huxley believed, knew only about Lyell. Referring to the contributions of Hutton and Lyell to the science of geology, Huxley frequently quotes Hutton rather than Lyell (who was present at the meeting): "If I have quoted the older writer rather than the newer, it is because his works are little

known, and his claims on our veneration too frequently forgotten . . ." (CE 8: 312). As Houpp and Pearsall suggest, writers should be aware of not only what the audiences know, but also what they do not know (20). How could have Huxley known about the audience's ignorance of the contributions of Hutton?

Huxley was an insider of the Society. He was the Secretary of the Society from 1859 to 62 and the President of it from 1869 to 71. A good speaker is a keen observer of his listeners' thoughts and opinions, says Cicero (223; bk. 1). As a member of the Society, Huxley would have known many of the listeners personally, their opinions about Darwinism, and their deficiencies.

In addition to the awareness of the experts' ignorance of the subject, Huxley perceived their misconceptions about the subject. He believed that the experts were opposing Darwinism on grounds that were not really accurate. He revealed this awareness in his letter to Hooker, written two days before the address on geological contemporaneity:

Darwin is met everywhere with--Oh this is opposed to palaeontology, or that is opposed to palaeontology--and I mean to turn around and ask, "Now, Messieurs les Palaeontologues, what the devil do you really know?" (L. Huxley 1: 220)

Though Huxley did not ask his audience exactly as he informed Hooker, he did not fail to point out their misconceptions regarding some of the paleontological

doctrines. Actually, his address dealt with their misconceptions only.

The earth is composed of various strata of rocks that form its crust. Geologists study the past history of the earth from the evidences given by the successive strata of rocks. The series of strata of the earth from one part of the world will be identical to the series of strata from another part of the world, provided the strata are not disturbed. According to geologists, the identical series were deposited at the same epoch--ranging anywhere from a hundred years to ten million years. Many paleontologists had assumed that the presence of the same kind of fossils in two strata at different parts of the world implied that the strata were contemporaneous. In his address, Huxley pointed out that the presence of identical fossils was an evidence against the formation of two identical strata in different parts of the world at the same time. This fact supported Darwin's theory of evolution, which opposed the notion of the appearance of similar animals at the same time on different parts of the earth. Though Huxley did not mention Darwinism to experts in this address, he helped them become aware of their misconceptions of the new theory.

Recognizing Their Attitude toward a Subject

Like knowing the audience's background knowledge of a subject, knowing its attitude toward the subject is also

important for the communicators. Depending upon their purpose, knowing the audience's attitude will encourage the communicators to present their subject for a favorable audience reception; or it may help them avoid discussing something disagreeable to the audience; or it may help them to set things straight if the audience's attitude is prejudiced. The following anecdotes reveal Huxley's awareness of audience's attitude toward his subject.

In 1860, just six months after the appearance of the Origin, the British Association for the Advancement of Science met at Oxford to discuss the theory of evolution in front of a mixed audience. There were scientists, clergymen, and members of the general public. Darwinism was in everybody's mind. At the Zoological Section of the Association, Huxley declined to discuss the issue on the ground that " a general audience, in which sentiment would unduly interfere with intellect, was not the public before which such a discussion should be carried on" (L. Huxley 1: 194). However, Huxley participated in the debate, which was an open clash between Science and the Church, held two days after.

The Bishop of Oxford, Bishop Samuel Wilberforce, represented the Church. He was widely known as "Soapy Sam" for his oratorical power and, as William Irvine notes, Huxley "knew that the Bishop was an able controversialist and felt that prevailing sentiment was strongly against the Darwinians" (4-5). The Bishop, as Leonard Huxley recounts

the events of the meeting, intended to "smash Darwin." Huxley suspected that the debate between the Bishop and the scientists would be "mainly an appeal to prejudice in a mixed audience, before which the scientific arguments of the Bishop's opponents would be at the utmost disadvantage" (L. Huxley 1: 193). Huxley was right in his anticipation of the mood of the audience.

Irvine and Peterson separately provide detailed accounts of the meeting. Huxley "observed the marked hostility of the audience toward the Darwinians" (Irvine 6). Bishop Wilberforce was "greeted with loud cheers and the waving handkerchiefs of the ladies," whereas, when Huxley was called for, "the audience greeted him with hardly a cheer" (Peterson 121). As Huxley anticipated, the Bishop won the day. "His audience was carried away by storm. Even those who were most resentful of his unfairness conceded the brilliance of his effort" (Peterson 120). This incident proves that Huxley was a shrewd judge of the situation and the sentiments of the people, perhaps the most important characteristic of a communicator.

One of his famous lectures during the fifties was about the relationship of man to lower animals. This topic, which was a series of lectures of that type in support of Darwinism, was criticized by the clergy. The Edinburgh Philosophical Institute and the city itself were opposed to the concept of any connection of man to lower animals. In these circumstances, when Huxley was invited to address the

Institute, he wrote to his wife about his feelings. Referring to the Edinburgh audience, he says, "They knew my views, so if they do not like what I shall have to tell them, it is their own fault" (L Huxley 1: 207). His recognition of their attitude toward his subject is further revealed when he addresses the city as the "saintly Edinburgh" and the "holy city."

Huxley's letter written to Darwin underscores what other scientists and religious men expected of this lecture: "Everybody prophesied I should be stoned and cast out of the city gate. . ." (L. Huxley 1: 209). Though the prophesy failed to happen, Huxley was right about the city's attitude toward the subject. Leonard Huxley describes the fury of the Witness, the local newspaper, which called his lecture an "anti-scriptural and most debasing theory . . . standing in blasphemous contradiction to biblical narrative and doctrine." It is the corruption of youth by "the vilest and beastiliest paradox ever vented in ancient or modern times amongst Pagans or Christians" and a "foul outrage committed upon them [the audiences] individually, and upon the whole species as 'made in the likeness of God.'" (L. Huxley 1: 109). Huxley's expectation of the holy city proved to be right. He never hesitated to set things straight in spite of his awareness of his audience's unfavorable attitude. This characteristic of Huxley is further manifested in his recognition of his audience's religious beliefs.

Recognizing Their Religious Beliefs

Like recognizing the audiences' attitude toward subject, Huxley recognized their religious beliefs however unfavorable they were against his views. Huxley's Collected Essays, Vol. 4, titled Science and Hebrew Tradition contains essays arguing that the accounts of the Creation and of the Deluge in the Hebrew scriptures are mere legends. Huxley's "Preface" to this volume discloses his awareness of the religious background of the general public: "The ordinary reader, to whom these essays are addressed, will doubtless be surprised, if not shocked, at the many passages which expressly, or by implication, contradict the notions respecting the age and authority of the Hebrew scriptures . . . in which he has been brought up" (ix). Many of the public readers would have doubtless been surprised because Victorian England was religious.

As Richard Altick points out, "the ordinary Victorian had been reared in a culture circumscribed by Christian teaching" (203). The Bible provided the accepted cosmogony. As Chalmers Mitchell explains, for the Catholics, the Bible was a quarry for doctrine, and for the Protestants, the Scriptures became the Word of God (248). Religion had determined the public's outlook upon life, its assessment of life's nature and purpose. The customs of society, says Gillian Avery, were greatly affected by religious practices (137). It was the custom of the most mid-Victorian Christians, emphasizes Geoffrey Best, to proclaim that

"Britain was essentially, a Christian country and that the British were a Christian people" (172). So Huxley was not wrong in predicting the surprise he was going to give to his readers.

Recognizing Their Age

At the Anthropological Conference on "Elementary Instruction in Physiology" (1877), Huxley reveals his awareness of the age of his audience. In Russia, he told his hearers, there was a religious belief among a sect that disease is brought about by the direct and special interference of God. Any attempt to prevent or cure the disease was considered by the people as blasphemous interference with the will of God. People in England were not different either.³ When chloroform was administered for the first time during child birth, it was resisted upon similar grounds. Huxley reminds the conference audience, "Many of us are old enough to recollect that the administration of chloroform in assuagement of the pangs of childbirth was, at its introduction, strenuously resisted upon similar grounds" (CE 3: 296). Huxley delivered this address in 1877 to an audience of teachers. Chloroform was first used in 1847, around forty years prior to his lecture. His recollection of the event along with the audience reveals his awareness of their age level.

Recognizing Their Gardening
and Love of Sports

In his fourth lecture of the working men series, Huxley explains to the workers the process of non-sexual propagation in plants. To tell them of the process clearly, he makes use of their gardening experience: "You are all probably familiar with the fact, as a matter of experience, that you can propagate plants by means of what are called 'cuttings'" (CE 2: 392-93). His awareness of this experience of his audience helps him to relate the process to their experiences.

Likewise, his awareness of their love for pigeons propels him to discuss the subject of selective breeding of pigeons with "humility and hesitation." He says,

I dare say there may be some among you who may be pigeon fanciers, and I wish you to understand that in approaching the subject, I would speak with all humility and hesitation, as I regret to say that I am not a pigeon fancier. I know it is a great art and mystery, and a thing upon which a man must not speak lightly. (CE 2: 411-12)

Why did he need this cautious introduction to the discussion of pigeons? As Wendell Mitchell explains, the breeding of pigeons was a popular pursuit among all sections of people. Queen Victoria, Mary Queen of Scots, Elizabeth Barrett Browning, and King George V were some of the prominent historical personages who raised pigeons. No other living

creature has won the interest, affection, and even veneration of mankind as has this bird. Mankind found an outlet for expression and a surcease from the tribulations of business and work in the breeding of pigeons (1).

In order to discuss the selective breeding process with the example of pigeons, Huxley had to approach the subject scientifically and dispassionately. He had to describe the distinct physical, anatomical, and habitual characteristics of the various breeds of pigeons. He had to refer to the "ridiculous manner" of the Pouter, which inflates its gullet with air. An awareness of his audience's love of pigeons would help not to hurt its sentiments.

Huxley was conscious of his audiences. Before he made speeches, he was thinking a great deal about them. He always tried to impress them. He was aware of their general characteristics such as their professional identity, education, age, beliefs, and love of sports. He was also aware of their specific characteristics, their background knowledge, and their attitude toward the subject. In addition to recognizing the general and specific background information of a particular audience, Huxley had perceived the diversity of his audiences too. He was aware of the multiple levels of audiences he was dealing with and the geographical and temporal differences that prevailed among them.

Huxley's remarks in his addresses, prefaces to various volumes, and personal letters reflect his concern for the

audiences. This concern helped him adapt his content to suit their background. A study of his content adaptation also proves indirectly his awareness of audience. In the next chapter, I will discuss the techniques Huxley followed to adapt his subject matter to suit his audiences.

Notes

¹Theodore Clevenger classifies all attempts of audience analysis into two categories: demographic analysis and purpose-oriented analysis. In the first analysis, communicators gather their audiences' general characteristics such as their age, education, and profession. In the second, they are concerned specifically with their audiences' knowledge, attitude, and opinion of the subject matter they will present to their audiences.

²See, for instance, Irvine, p.4 and Peterson, p.117.

³Chloroform was discovered in 1836, but introduced in surgery in 1846 and later in childbirth. The religious, the medical, and the lay people were all against the use of chloroform. Almost until the beginning of the nineteenth century, men's idea about disease had continued to flow along the same conduits of thought. Diseases were considered to be the result of the wrath of supernatural beings. Any attempt to cure the suffering by medicine was interpreted as an interference with the Will of God. Virginia Thatcher refers to Half a Century of Anaesthesia, published in 1896, for the reactions of the religious against the use of anesthesia: "When anesthesia was first

introduced a great outcry was raised against it from the pulpit because it was said to interfere with the degrees of Providence that mankind should suffer" (16). She continues to account for the reaction: "The most publicized of these controversies centered in the use of anesthesia to relieve the pain of childbirth. This was an act in defiance of Divine Will: 'In sorrow thou shalt bring forth children.'" Randolph Pawling points out that every physician was against it: "Childbirth was 'physiological' and, therefore, natural and not to be interfered with" (48).

CHAPTER IV

CONTENT ADAPTATION

Speech is like a feast at which the dishes are made to please the guests, and not the cooks.

The members of an audience, who assemble to hear a popularizer, are his guests, who have come to hear him. Therefore, it is his responsibility to make his speech comprehensible to the guests. The simile likens a speech to the dishes that are pleasing to the guests and not the cook who actually makes them. The cook pleases the guests not only by making the dishes, but also by the way he serves them or, if you will, decorates them. Similarly, a popularizer may please his audience by adapting the content and the presentation techniques of his subject to his audience's background. Audience analysis helps him accomplish both.

Before proceeding, let me briefly define the terms content adaptation and presentation techniques. I use content adaptation in a sense similar to Theodore Clevenger's "message planning." According to him, message planning consists of selecting a topic, determining the purpose of speech, analyzing the methods of development, choosing the supporting details, and selecting appropriate

levels of language (34). Similarly, Content adaptation denotes the selection of a subject matter, the level of treatment of the subject, and the details to be elaborated, summarized, or altogether omitted. Presentation techniques, by contrast, refers to stylistic devices such as analogy that help Huxley to communicate scientific content understandably and interestingly to lay audiences. I will discuss Huxley's presentation techniques in the next chapter, and content adaptation in this chapter.

How does Huxley adapt his subject matter to the general public? First, I will provide the general theory of his content adaptation, follow this up with a detailed discussion of it, and finally compare his essays on similar topics to diverse audiences--all aimed at highlighting his successful content adaptation strategy. To discuss his content adaptation, I focus mainly on his popular audiences, namely the general public and the workers. Also, I will compare his essays to experts with those to lay audiences to further illustrate his content adaptation strategy. Because of the lack of information about the changes Huxley had made when he translated his speeches to written form, my discussion of content and presentation techniques applies generally to the two forms of communication. Moreover, as I mentioned in the earlier chapter, lecture, address, and essay are used interchangeably and audience refers to both listeners and readers.

General Discussion of Huxley's Content Adaptation

A sense of architectural beauty emerges in the mind of a reader when he reads Huxley's popular essays. An intricate design is central to Huxley's style of content adaptation. Huxley was fascinated from the beginning by a sense of architectural design that pervaded all living beings:

What I cared for was the architectural and engineering part of the business [physiology], the working out the wonderful unity of plan in the thousands and thousands of diverse living constructions, and the modifications of similar apparatuses to serve diverse ends" (CE 1: 7).

This design provides Huxley with the content as well as the strategy for adapting that content for many popular essays.

Exposition of this design--the unity among the diverse forms of life--is the central idea of many of Huxley's popular essays. To express this design, Huxley adopted a strategic design of his own that attracted the compliments of his colleagues. Professor Ray Lankester recalled some of them: H.E. Armstrong calls Huxley a "master of intellectual design." Edward Clodd sees the design to be the result of a "passion for logical symmetry." Hugh Walker, the Victorian critic, compares Huxley's style to a building--"destitute of ornament, but beautiful by reason of its outline and proportion" (311). While these compliments point out

Huxley's love of form in general, Houston Peterson's comment about this subject is specific to Huxley's popular essays, the "Six Lectures." Referring to these lectures, he states that "each of six lectures was a model of arrangement (141). Huxley uses this architectural design as the organizing principle for content adaptation. What are the significant features of such adaptation strategy?

Whether it is an essay or a series of lectures, Huxley's subject matter for the general public has usually been complex. Through physical entities and objects, he presents the audience a vision of complex natural phenomena. In order to explain a complex subject to laymen, Huxley divides the subject matter into small units of ideas, which is the first phase of Huxley's content adaptation design.

The second phase of the design consists of structuring the small units. They are mini-essays in themselves, having their own beginning, middle, and end, and thus working independent of each other. Though they are structurally independent in the overall organization of an essay, they collectively contribute to the total meaning of the essay. Each unit advances the readers by one step toward the understanding of the complex idea in its entirety.

The third phase of the design involves the amount and complexity of details. Each unit deals with the most simple and basic concepts or principles that are necessary for the readers to understand the following unit and the subject as a whole. Huxley excludes all complex, technical details

from the units.

Fourth, because the subject matter is scientific and new to the popular audiences, Huxley needs to explain to them all relevant aspects of the subject. For instance, to convey the idea that all plants and animals have similar protoplasm, Huxley has to introduce the public to the morphological differences between plants and animals, the histology of cells, and their physiological activities. Discussion of all the fundamental aspects of a subject results in a wide coverage of the subject. Thus, Huxley's subjects are often very comprehensive, encompassing many related fields of study.

Finally, in addition to presenting the subject matter, Huxley refers to the current issues or controversies that surround the subject matter and informs the lay audiences of his views. Most of his popular lectures discussed evolution. He was the center of various controversies on the issue and the public was curious to know about his views on the issue. Therefore, Huxley combines the plain facts of scientific exposition with his personal views when he addresses the lay audiences, a feature that is totally absent in his addresses to experts and students. A detailed discussion of the various phases of the design will illustrate clearly Huxley's content adaptation strategy.

Detailed Discussion of His Content

Adaptation Techniques

Of Huxley's many popular essays, I will focus on the six lectures on evolution to the working men entitled "On Our Knowledge of the Causes of the Phenomena of Organic Nature." (Subsequently I will refer to the work as "Six Lectures.") Published in a pamphlet form, these lectures sold in large numbers (L. Huxley 1:223). When the book reached America, Edward Livingston Youmans (1821-1887), the American chemist and educationist who was a friend of Huxley, Spencer, and Tyndall and many leading scientists of his time, described the book as "the most perfect little gem of a book I have met with" (qtd. in Cyril Bibby Scientist 99). The book is in fact an exposition of Darwin's Origin. On reading this book, Darwin himself commented, "What is the good of writing a thundering big book when everything is in this little green book, so despicable for its size? In the name of all that is good and bad, I may as well shut up shop altogether" (Frances Darwin and A.C. Seward 1: 230). Along with this popular book, I will also use many of his popular essays to discuss his content adaptation.

Dividing Complex Subject

into Small Units

After listening to one of his lectures to the working men, Frederic Harrison observed, "Last night's lecture I thought a type of a popular exposition, central, broad,

clear, positive, suggestive and elementary" (qtd. in Peterson 139). The six phases of the design reveal all the characteristics that Harrison observed in Huxley's lectures. First, Huxley divides the complex subject into small units of information so that his readers can easily comprehend the units one at a time or step-by-step. For instance, the "Six Lectures" discusses the organic nature of the world, the origin of life, and the process of evolution. In the first lecture, he conveys two complex concepts of the organic world: 1. the interrelationship of the animal and plant kingdoms and their dependence on the inorganic world for life and 2. the single cellular origin of all animals including man.

To understand the two features, readers must be familiar with the basic morphological, anatomical, and physiological nature of animals. Hence, Huxley explains these basic features of animals through the example of a horse and then points out the animals' dependence on plants for food. Then, he highlights the similarities between man and other animals. The following chart illustrates the division of the complex subject matter into small units:

- * External structure of a common horse
- * Internal structure of the horse
- * Physiology (only the digestive process) of the horse
- * Dependence of it on the vegetable kingdom for food
- * Interrelationship between the animal and plant kingdoms

- * Relationship of the two kingdoms to the inorganic world
- * Single cellular origin of the horse
- * The similarities among all animals including man at this level
- * The unity amidst apparent diversity of the animal kingdom

The concept of unity among diversity is the whole idea of the essay, which must have been quite complex to the workers. Even the educated lay audience of Huxley's time was ignorant of the zoological classification of animals and of the inherent structural and physiological similarities among them. In order to see the nature of the organic world, the workers must grasp such ideas as the unity of plan among diverse animals, the dependence of animals on the plant kingdom for food, and the cyclic nature of the organic and inorganic worlds.

Though Huxley has to explain all the ideas, he cannot combine them, for the workers would find it difficult to comprehend all of this if they were given it as a whole. The complex or whole idea, thus, needs to be divided into small units, like providing small doses or spoonfuls of medication to children whose consumption of medicine is limited by their age. Like the children, the workers are limited by their lack of knowledge of science. Hence, small doses, spoonfuls, or units of information are essential for their understanding and retention of the total subject

matter.

Treating Each Unit Independently

The division of a complex idea into small units may not be unique to the lay audience. Even for an expert audience, a writer may divide the idea into small units for readability and quick comprehension. However, Huxley's small units for the workers are unique, for he treats each unit as a mini-essay in itself. Each unit has its beginning, middle, and end. The whole essay is like a string of beads, each one complete in itself but at the same time playing its part in constituting the whole string.

For instance, two successive units in his first lecture of the "Six Lectures" deal respectively with the anatomy of the horse and its physiology. Note how Huxley begins the physiology unit:

Having thus, in this sort of general way, sketched to you what I may call, perhaps, the architecture of the body of the horse (what we term technically its Morphology), I must now turn to another aspect. A horse is not a mere dead structure: it is an active, living, working machine. (CE 2: 311)

With this introductory comment that "the horse is not a mere dead structure," but "an active, working" body, he starts describing its digestive and locomotive processes. The middle of the unit is the elaboration of these two

processes. Then, when he reaches the end of the unit, he summarizes it by saying, " You have here an extremely complex and beautifully-proportioned machine with all its parts working harmoniously together towards one common object--the preservation of the life of the animal" (CE 2: 313).

Though each unit remains complete, the understanding of it is essential for readers to comprehend the following unit. Each unit provides the background information to the next unit. For instance, as the outline (see above) illustrates, Huxley describes first the anatomy of the horse in general. An understanding of the anatomy helps readers follow the next unit of information about the digestive process of the horse. Also, the presentation of information is cumulative. For example, while explaining the digestive process, he tells the workers of the dependence of the animal on the vegetable kingdom for its food, which is discussed in detail in the next unit. Comprehension of the individual units, as they are organized, helps readers assimilate the information they have gained and perceive the complex nature of the organic world that gradually emerges through the various units.

Treating Individual Units

Generally

However complex a subject matter may be, Huxley treats the individual units broadly, providing only a general

overview of the subject. He elaborates on only the basic matters, summarizes related technical matters, omits complex details, and avoids in-depth discussion. For instance, before he begins the first lecture, he says, "I shall endeavour to put before you a sort of broad notion of our knowledge of the condition of the living world" (CE 2: 305). Promising at the outset of the lectures to explain only broad feature, he carries it out to its end.

To explain the cellular origin of the tissues and the chemical composition of the cells, Huxley openly tells the audience, "I now speak merely of the general character of the whole process" (CE 2: 310). He explains only that the tissues of the body, bone, muscle, and skin are all composed of cells and that all cells are basically composed of carbon, hydrogen, oxygen, and nitrogen. He does not dwell upon the various types of tissues and their unique characteristics. The chemical composition of cells is, likewise, a complex subject, but Huxley does not discuss its complexities.

Similarly, once he has provided the readers with the morphology of the horse, Huxley moves on to the physiology of the animal. And how deeply did he express the morphological characteristics of the animal? He tells them, "Having thus, in this sort of general way sketched to you . . . the architecture of the body of the horse . . . I must now turn to another aspect" (CE 2: 310-11). He discusses only the basic anatomical characteristics that are essential

for the audience's understanding of the following description of the physiological functions of the animal.

When Huxley concludes the first lecture, he sums up the essay and previews the second lecture. The summary and the preview underscore the general treatment he gives to the subject. Referring to the first lecture, he says, "It gives you the great outlines of a vast picture, which you must fill up by your own study" (CE 2: 329). Referring to the next lecture, he announces, "In the next lecture I shall endeavour in the same way to go back into the past, and to sketch in the same broad manner the history of life in epochs preceding our own" (CE 2: 329). Thus, he provides the audience with the general idea of the subject without having to go into the details of it.

Treating Units at Their Elementary Level

In explaining scientific matters to the lay audience, Huxley himself repeatedly insists that he begins at the beginning and provides only the fundamentals. The nature of the treatment of the subject, as he comments, is the "extremely elementary exposition of the structural relations of animals" (CE 2: 325). At the beginning of the first lecture he tells the workers, "And here, as it will always happen when dealing with an extensive subject, the greater part of my course . . . must be devoted to preliminary matters" (CE 2: 304). Mostly, his lectures consist of such

"preliminary matters"; he tells the audience of the nature and history of the present and the past organic and inorganic worlds as well as the relationship between them before he proceeds to discuss the merits of Darwin's theory.

Omitting Complex Details

Huxley does not lay all the available details in front of the audience. For instance, our nervous system conducts electrical impulses, as proven by Dubois Reymond and others. Huxley does not elaborate these points in the series; instead, he makes a sweeping statement:

There are a number of other facts and phenomena of that sort; so that we come to the broad conclusion that not only as to living matter itself, but as to the forces that matter exerts, there is a closer relationship between the organic and the inorganic world" (CE 2: 317-318).

What are those "other facts and phenomena"? Why did Huxley not choose to talk about them? For one reason, he had already provided many simple proofs to point out the relationship between the two worlds. For another reason, the omitted information involves the complex, technical details of many experiments, and discussing them might be superfluous and difficult for the workers to comprehend.

Avoiding In-depth Discussion

Along with complex details, Huxley also avoids in-depth

discussion for the lay audience. In the following excerpt, he recounts the conception of an embryo in horses:

In both [sexes], certain products or parts of the organism have been set free, certain parts of the organisms of the two sexes have come into contact with one another, and from that conjunction, from that union which then takes place, there results the formation of a new being. (CE 2: 318)

This general account--almost a vague description--does not relate any technical details. He does not discuss, for instance, the journey of the ovum down the fallopian path and the complex changes that it undergoes before, during, and after fertilization.

Even if one assumes that the omission of details in the above description is an effort not to offend the mores of his audience, the following description clearly reveals Huxley's efforts to avoid technical details. Immediately following the account of conception, Huxley describes the changes the embryo undergoes after fertilization. Note again the lack of complex, technical details:

This minute particle of matter which may only be a small fraction of a grain in weight, undergoes a series of changes,--wonderful, complex changes. Finally upon its surface there is fashioned a little elevation, which afterwards becomes divided and marked by a groove. The lateral boundaries of the groove extend upwards and downwards, and at

length give rise to a double tube. In the upper end of the smaller tube the spinal marrow and brain are fashioned; in the lower, the alimentary canal and heart; and at length two pairs of buds shoot out at the sides of the body, and they are the rudiments of the limbs. (CE 2: 318-319)

What he provides here is a general summary of the complex process of embryo development. As Huxley himself indicates in the beginning of the passage, the embryo undergoes a series of "complex" changes. But without explaining the complex details, he summarizes the series in a few sentences, for his purpose in this lecture is to indicate the identical structure of all embryos. Hence, the development of the embryo need not be discussed in detail.

Covering Many Related Fields

Whatever topic Huxley chooses to deliver to the workers, he provides them with its broad features. The features cover all related aspects of the topic. For instance, his "Six Lectures" is an attempt to shed light on the facts and principles of Darwinism so that the workers can judge Darwin's Origin intelligently. The lectures cover various related fields of the animal kingdom: taxonomy, morphology, physiology, anatomy, embryology, histology, ecology, and paleontology. For example, the first lecture, discussing the present condition of the organic world, leads the workers to the fields of anatomy and physiology. The

second lecture, analyzing the validity of geological evidence, introduces them to the study of geology. The third lecture familiarizes the workers with the inductive and deductive processes of scientific investigation. Thus, to cover the topic, Huxley familiarizes the workers with all related fields of study. Like a series of many lectures, even a single essay takes the workers to many fields of study. For instance, his lecture "On a Piece of Chalk" takes the workers to the structural and chemical composition of chalk, a marine survey, the morphology of marine animals, local geography, and geology.

Discussing Contemporary Issues

Lloyd Bitzer argues that the audience in a spoken communication has a defined presence outside the discourse and has certain beliefs, attitudes, and relationships to the speaker and to the situation. "Then," he declares, "the discourse needs to have certain characteristics in response to the situation and audience" (12). Douglas Park echos the same idea: "We need to see all discourse as representing action performed within and conditioned by a social situation" (484). Huxley's essays to the lay audiences address certain social issues of his time. Referring to Huxley's lectures to the workers, Harrison observes that the "radical ideas of biology [are] handled from a social . . . point of view" (qtd. in Peterson 139). While addressing the lay audiences on evolution, Huxley draws their attention to

the conflict between Darwin's theory and religious beliefs. He also tells this audience his personal opinions on such matters, something which he never attempts in his addresses to experts or students.

Though Huxley proclaimed himself an evolutionist in his public lectures, he never mentioned the word in the courses he taught students. When Father Hahn (S.J.), who was a student of Huxley, expressed his surprise on this matter, Huxley replied,

Here in my teaching lectures . . . I have time to put the facts fully before a trained audience. In my public lectures I am obliged to pass rapidly over the facts, and I put forward my personal convictions. And it is for this that people come to hear me. (L. Huxley 2: 428)

Hence, we may see in Huxley's public addresses his opinions expressed in clear terms.

Huxley's "Six Lectures" reveals clearly that his task in expostulating Darwinism is two-fold: To explain the basic principles and concepts of the evolutionary mechanism in nature and to give his opinions of evolution and of the Origin. In the very beginning of the first lecture, he modestly tells the audience about his plan:

All I shall attempt to do, is to put before you that kind of judgment which has been formed by a man, who, of course, is liable to judge erroneously; but, at any rate, of one whose

business and profession it is to form judgments upon questions of their nature. (CE 2: 304)

But he reserves his personal judgments until he reaches the end of the six lectures. Once he has provided the audience with all the necessary information about the theory of evolution, he then turns to his own opinions, and only in the last lecture.

There are many hypotheses about evolution. But which one does Huxley accept? Does he accept it unconditionally? Or does he have any reservations? He says,

You must recollect that when I say I think it is either Mr. Darwin's hypothesis or nothing; that either we must take his view, or look upon the whole of organic nature as an enigma, the meaning of which is wholly hidden from us; you must understand that I mean that I accept it provisionally, in exactly the same way as I accept any other hypothesis. (CE 2: 468)

Huxley explains that as a man of science, he would welcome any hypothesis that can be tested by scientists and would help man to widen his knowledge. If Huxley accepts the theory of Darwin provisionally, what is his opinion about those who opposed the theory and about the controversies that surround the theory? He explains,

Although it has been my business to attend closely to the controversies roused by the publication of Mr. Darwin's book, I think that not one of the

enormous mass of objections and obstacles which have been raised is of any great value. . . .

[They] are misunderstandings of some sort, arising either from prejudice, or want of knowledge, or still more from want of patience and care in reading the work. (CE 2: 469)

Why does one require patience and care in reading the Origin? How did Huxley read the book? Did he approach it with patience and care?

It is not a book to be read with as much ease as its pleasant style may lead you to imagine. You spin through it as if it were a novel the first time you read it, and think you know all about it; the second time you read it you think you know rather less about it; and the third time, you are amazed to find how little you have really apprehended its vast scope and objects. I can positively say that I never take it up without finding in it some new view, or light, or suggestion that I have not noticed before. That is the best characteristic of a thorough and profound book; and I believe this feature of the "Origin of Species" explains why so many persons have ventured to pass judgment and criticisms upon it which are by no means worth the paper they are written on. (CE 2: 469-70)

So how does he look at the book? What is its contribution

to the theory of evolution? To science itself? To the welfare of humankind? The following concludes the sixth lecture:

In conclusion, let me say that you may go away with it as my mature conviction, that Mr. Darwin's work is the greatest contribution which has been made to biological science since the publication of the "Reigne Animal" of Cuvier, and since that of the "History of Development" of Von Baer. I believe that if you strip it of its theoretical part it still remains one of the greatest encyclopaedias of biological doctrine that any one man ever brought forth; and I believe that, if you take it as the embodiment of an hypothesis, it is destined to be the guide of biological and psychological speculation for the next three or four generations. (CE 2: 474-75)

Not only in his addresses to the workers, but also in his lectures to other lay audiences, Huxley reveals his personal opinions on contemporary or controversial issues.

Huxley's Content Adaptability:

From a Different Perspective

As many critics of audience analysis point out, a speech must be appropriate to an audience and its purpose and to a speaker and his intentions. For a popularizer of science, the background of the audience members may vary but

not their intention: Usually they all come to hear the popularizer speak about one scientific topic or another. Hence, the popularizer's content adaptation depends on his listeners' background and his own purpose. In the following pages, I will analyze Huxley's lectures addressed to diverse audiences to illustrate his content adaptability in various situations.

To prove Huxley's content adaptability, one has to compare essays addressed to diverse audiences on similar topics. When I looked for such comparable essays, I found three different types:

1. essays on similar topics to entirely different audiences: experts and lay audiences
2. essays on similar topics to the same type of audiences but with different philosophical interests and affiliation
3. essays on similar topics to almost the same type of audiences with similar educational and philosophical background

Adapting to Audiences with Extreme Differences

Huxley's essays on geological contemporaneity and the six lectures to the working men both deal with the concept of progressive modification and persistent types. Huxley's treatment of these concepts in the two addresses reveals his awareness of audience and content adaptation. Huxley

delivered "Geological Contemporaneity and Persistent Types of Life" in 1862 to the expert audience of the Geological Society. Sir Charles Lyell describes the nature of the essay: "Huxley delivered a brilliant critical discourse on what palaeontology has and has not done" (L. Huxley 1: 220). In his letter to Hooker, Huxley himself mentioned the nature of the essay: "I am going to criticise Palaeontological doctrines in general" (L. Huxley 1: 220). This "critical" essay pointed out to the experts that the living population of the earth has undergone slow and gradual changes. However, the total amount of change in the forms of these animal and vegetable species, since the time the existence of such forms first recorded, is small. Moreover, in each one of the great groups of this population there are some "persistent types," which have remained with very little apparent changes from their first appearance to the present time.

The paleontological facts provide no support to the doctrines of progressive modification, which suppose that modification has taken place by a necessary progress from more to less embryonic forms, from more to less generalized types, within the limits of the period represented by the fossiliferous rocks.

While discussing the techniques of audience analysis, Houp and Pearsall point out to writers, "You must know what your readers will understand without explanation" (20). Huxley practiced that sense of awareness in his essays.

When he addresses the experts of the Geological Society, he does not explain or elaborate the concept of progressive modification; instead, he just mentions it (CE 8: 298). In his address to the workers, on the other hand, he explains the concept of progressive modification illustratively (CE 2:465-451). For instance, he illustrates how a horse and a rhinoceros have descended from the same stock. He explains how the sheep and the cow have characteristics similar to those of their primitive ruminant stock. He illustrates how the whalebone whale (which has horny "whalebone " plates in its mouth but no teeth) and the whale with teeth in its mouth both spring from the same primitive stock. Thus, while merely reminding the experts of a concept, Huxley elaborates it to the lay audience.

In other instances, Huxley finds it necessary to elaborate a concept to both types of audiences. In such cases, he provides complex technical details to the experts, but only general, non technical details to the lay audience. For example, he discusses in detail the concept of persistent types to both the audiences. To geologists, he provides all the technical information regarding the concept. He catalogs each great division of the animal world in succession and points out how almost all members of each division are closely related to one another in the division. For instance, he points out to the experts the persistent type in fishes:

Among fishes I have referred to the Coelacanthini

(comprising the genera *Coelacanthus*, *Holophagus*, *Undiana*, and *Macropoma*) as affording an example of a persistent type; and it is most remarkable to note the smallness of the differences between any of these fishes (affecting at most the proportions of the body and fins, and the character and sculpture of the scales,) notwithstanding their enormous range in time. In all the essentials of its very peculiar structure, the *Macropoma* of the Chalk is identical with the *Coelacanthus* of the Coal. Look at the genus *Lepidotus*, again, persisting without a modification of importance from the Liassic to the Eocene formations inclusively. (CE 8: 297)

Note the technical names used to refer to different genera of fishes and rock formations. Also note the inclusion of the details regarding the minute changes in their physical appearance.

Huxley presents the same concept of persistent type to the workers, too, but before pointing out the persistent type in animals, he defines the term, something he did not do in his address to the experts:

There are some groups of animals and plants, in the fossil world, which have been said to belong to "persistent types," because they have persisted, with very little change indeed, through a very great range of time, while everything about

them has changed largely. (CE 2: 462)

After providing this explanation, he illustrates the concept using the fish genera. Note the generality of the content and the elimination of technical terms:

There are families of fishes whose type of construction has persisted all the way from the carboniferous strata right up to the cretaceous; and others which have lasted through almost the whole range of the secondary rocks, and from the lias to the olden tertiaries. (CE 2: 462)

He had already explained the different types of rock formation to the workers. Hence references to the rock types should offer no problem to the workers. In addition to the exclusion of technical terms, this time he has eliminated description of the minute changes in the physical characteristics of the fishes, and he does not provide a long catalog of the entire animal kingdom to illustrate the persistent types as he did for the experts. Thus, in this situation where he addressed two polar audiences on similar subjects, Huxley adapts the content to the background of the audiences.

Adapting to Audiences of Different Philosophical Interests

The second type of situation consists of Huxley's addresses on similar topics to similar type of audiences differing in their philosophical interests. For instance,

in 1870 he delivered to the Cambridge Y.M.C.A. audience a speech entitled "A Commentary on Descartes' 'Discourse Touching the Method of Using Reason Rightly, and of Seeking Scientific truth.'" In 1874, he gave the members of the British Association for the Advancement of Science at Belfast the address "On the Hypothesis that Animals Are Automata, And Its History." As the audiences' organizational affiliation indicates, the former was religiously oriented and the latter was scientifically oriented. Apart from this philosophical difference, the two groups of audiences were all laymen, and they had come to hear about the scientific works of Descartes. Though Huxley addressed both of them on Descartes, he made appropriate changes in the substance of the essays. To the former he emphasized the modern philosophical inquiries of Descartes on materialism and idealism, but to the latter, he emphasized the physiological works of Descartes.

In the former essay, Huxley showed the Christian audience that "Descartes lived and died a good Catholic, and prided himself upon having demonstrated the existence of God and of the soul of man" (CE 1: 196). Though Huxley's main focus was on explaining the philosophy of Descartes, he also briefly discussed Descartes the physiologist, who stated that the animal body (including the human body) is an automaton competent to perform all the animal functions in exactly the same way as a clock or any other piece of mechanism.

However, to the audience of scientists, Huxley expanded what he briefly discussed with the Christian audience: the physiological work of Descartes. In this address he elaborated on Descartes' work on the physiology of motion and sensation. Huxley explained that many modern physiological concepts of the nervous system are fully expressed and illustrated in the writing of Descartes (CE 1: 216). Huxley then elaborated Descartes' doctrine that animals are machines or automata, devoid of reason as well as consciousness. In his lecture to the Christian audience, Huxley was explaining Descartes' doctrine of animal automatism as it appears in his work Discourse. But in his address to the B.A.A.S., in addition to the Discourse, he elaborated the physiological material in Descartes' other works. Thus, in this type of situation, he adapts his content to the special interest of the audience.

Adapting to Suit His Intention

The third type of situation consists of Huxley's essays on similar topics to similar type of audience with similar backgrounds and philosophical interests. For example, he revealed his views on materialism to the Edinburgh Philosophical Institution audience in 1869, an audience similar to the Y.M.C.A. audience he would address the following year.

Huxley's address to the Edinburgh audience, "On the Physical Basis of Life," includes scientific and

philosophical sections. The first section deals with the scientific matter of the composition of cells. In it, he reduces life and the mind to chemical processes. He explains that the basic structural unit of the living body, whether it is animal or plant, is made up of similar material. Also, the vital action and even thought of living beings are ultimately based upon the molecular changes that take place in the cells.

Huxley anticipated that he would be called a gross materialist for advocating a scientific concept that consisted of the victory of matter and causation over spirit and spontaneity. As he anticipated, religious leaders labelled this vision materialistic (CE 1:160). Hence, in an effort to escape from the accusation, he shares his philosophy of materialism with the audience in the second part of this address.

How much of his philosophy of materialism does Huxley share with this audience? In the first section he made it clear that human life and mind can be reduced to the chemical processes of molecules. In the second section, he admits that scientific terms, such as protoplasm, used in the first section, "are distinctly materialistic" and that such terminology is essential to scientific workers. But he assures the audience that he is not a materialist and believes "materialism to involve grave philosophical error." Following Hume's skepticism, he asks the audience whether matter is not merely "the name for the unknown and

hypothetical cause of states of our own consciousness" (CE 1: 160).

Regarding the Y.M.C.A. address given the following year, Leonard Huxley observes, "Here again, as in Physical Basis of Life, but with more detail, he explains how far materialism is legitimate, is in fact, a sort of shorthand idealism" (L. Huxley 1: 352). Why does Huxley discuss the legitimacy of materialism in great detail? Though he called the Edinburgh audience the people of the "holy city," the nature of the institution guaranteed free discussion of philosophical issues, but the Y.M.C.A. was religious through and through and Huxley was perplexed when faced with choosing an appropriate topic for that audience:

When you did me the honour to ask me to deliver this address, I confess I was perplexed what topic to select. For you are emphatically and distinctly a Christian body; while science and philosophy, within the range of which lie all the topics on which I could venture to speak, are neither Christian, nor Unchristian, but are Extrachristian, and have a world of their own.

(CE 1: 195)

Any attempt to legitimize materialism would be certainly against the spirit of the Christian audience. But Huxley's purpose is to unfold the vision of the Extrachristian world. Seeking truth is not unchristian and Huxley wants to tell this audience about the philosophers, who spent all their

life time seeking the Truth. Huxley declares in this discussion:

You would become aware that the philosophers and the men of science are not exactly what they are sometimes represented to you to be; and that their methods and paths do not lead so perpendicularly downwards as you are occasionally told they do.

(CE 1: 195)

Huxley tells them of the life and philosophy of one such man, Descartes. This address is a most extravagant eulogy of Descartes as the pioneer of all modern thought.

In the previous essay, Huxley's philosophy of materialism dealt strictly with Hume's skepticism and the useful terminologies the philosophy has to offer to scientists. In this essay, he shows materialism to be one of the two aspects of Descartes' Discourse, the other being idealism. He also insists to the audience that these two lines of thought are complementary, not antagonistic. Thus, for this Christian audience, he discusses materialism in the wider context of the Extrachristian world vision.

In this situation, Huxley adapts the content to suit his intentions: to tell the Edinburgh audience that materialism provides necessary tools for the progress of science and to tell the Christian audience that materialism is not necessarily contrary to Christianity. An analysis of all the three types of situations, thus, reveals that Huxley planned his essays to meet the demands of the situation,

which include the speaker, the hearer, and their purposes.

To sum up, Huxley's content adaptation strategy involves many techniques. First, he divides complex ideas into small units of information. Second, each unit is a mini-essay in itself, having its own beginning, middle, and end. Though each unit stands independently of the other units of the essay, all units collectively contribute to the total meaning of the essay. Third, the units contain information that is general and basic. Fourth, however general the information may be, it encompasses a wide spectrum of related fields of study. Finally, the adaptation strategy includes the revelation of Huxley's personal opinions about various issues that surround the subject matter because the public was curious to know them.

The success of a popularizer depends not only on how well he adapts the subject but also on how well he adapts his style of presentation to the background of the audience. Huxley adapts the subject matter very effectively, but how does he adapt the stylistic techniques? In the next chapter, I will analyze in detail the stylistic devices that he uses to communicate with the lay audiences.

CHAPTER V

STYLISTIC ADAPTATIONS I

Why forego pleasures, turn your back on the world, the flesh, and the devil, and devote your life to erudition, observation, and the pen if you cannot get an audience, if no one cares to read what you write? This moral is one of the first that Huxley impressed upon you, namely, write to be read; if necessary, 'stoop to conquer,' employ all your arts and wiles to get an audience in sciences, in literature, in the arts, in politics.

--Henry Fairfield Osborn,

qtd. in Blinderman, "Semantic Aspects"

If "write to be read" is indirect, "employ all your arts and wiles" is not: Both of them underscore the importance of adopting appropriate strategies to reach an audience. In the last chapter, I discussed Huxley's strategy for content adaptation. In the following chapter, I shall analyze the stylistic devices he employs to present a subject to lay audiences.

Huxley uses significant stylistic adaptations in his popular scientific prose. (As I mentioned before, I do not maintain any distinction between Huxley's addresses and essays. Moreover, the stylistic devices discussed here are

appropriate to both types of communication.) While many different aspects of his presentations could be considered, I restrict my attention here to five prominent stylistic devices:

- * Scientific windows
- * Commonplace and Local Examples
- * Figures of speech
- * Human interest
- * Language

I shall discuss the first three stylistic devices in this chapter and the last two in the next chapter.

Scientific Windows

Huxley's popularizing method can be called exposition by illustration, which works on two levels. On a broad level, as a scientific window, it offers a general, large field of vision of nature to readers. This large vision is composed of the intricate, apparently chaotic maze of the principles and the operation of nature's laws. On a specific level, Huxley uses another set of illustrative techniques, namely common and local examples, to explain these intricacies.

Throughout his life, Huxley did research and carried his findings to the public. His philosophy that science is "not the providence of the few, but the possession of the many" (L. Huxley 1: 313) always compelled him to share his vision of the complex world with lay audience. To do this,

he used what Albert Ashforth has called a scientific window: a "unique kind of scientific exposition" (56).

"To a clear eye," Huxley said, "the smallest fact is a window through which the Infinite may be seen" (CE 8: 209). By smallest facts he meant objects familiar to lay audience such as coal, yeast, and chalk. Using these objects as windows, Huxley let his audience view the universe and man's place in it.

The windows Huxley used are common physical entities, but the vision they offered to the lay audience consists of the general principles of science. For instance, a lump of coal and a piece of chalk explain the principles of geologic deposition; the anatomy of a lobster illustrates the principles of evolutionary biology; and an yeast plant explains the chemical phenomenon of fermentation.

The scientific window is not original with Huxley; Michael Faraday used it before him. In The Chemical History of a Candle, Faraday helped an audience of young people at the Royal Institution in London to see a variety of fundamental scientific lessons through an unpromising object, a rod of wax with its plaited wick.

The scientific window takes shapes from Huxley's conception of science teaching. In "A Lobster: or, the Study of Zoology," he lectured school-teachers on the method of instructing school students in the various branches of zoological science:

Let us take some concrete living thing, some

animal, the commoner the better, and let us see how the application of common sense and common logic to the obvious facts it presents, inevitably leads us into all these branches of zoological science. (CE 8: 199-200)

He urged the teachers to illustrate the animal world through a familiar representative of the world.

Not only did Huxley preach the method, but he also practiced it in his teaching and in the textbooks that he wrote for students. As L. Huxley points out, Huxley's Physiography was a popular textbook: "the fore-runner of an immense number of school-books in the subject" (1: 333). In it he teaches students the fundamental scientific concepts of zoology, chemistry, geology, geography, astronomy, and meteorology by focusing their attention on the Thames river. The entire book traces the course of the river and, in the process, introduces the students to a complex vision of the universe. This method of exposition became central to Huxley's many popular works.

In 1880, Huxley, the chemist Sir Henry Roscoe, and the physicist Balfour Stewart became general editors of a series of Science Primers for the English Publishing House of Macmillan. As Chalmers Mitchell points out, "These were written in simple language, suitable for those with no preliminary knowledge of science, but were the work of the chief authorities in the leading branches of science" (171). Huxley himself wrote the introductory volume to this great

series. What method did he adopt in writing this book?

Enclosing the manuscript of the Science Primer:

Introductory, he wrote to Roscoe: "You will see that the idea is to develop Science out of common observation, and to lead up to Physics, Chemistry, Biology, and Psychology" (L. Huxley 2: 2).

For the introductory book, Huxley selected a common, natural substance of the world and ordinary chains of cause and effect that can be observed around us: "One of the commonest of common natural objects is water; everybody uses it in one way or another everyday; and consequently everybody possesses a store of loose information--of common knowledge about it" (19). This "loose information" he refers to is what Pearsall and others refer to as readers' experience. Huxley always relates to this experience of readers in his popularization. In this book, he says, "We may as well make a beginning of science by studying water" (19). What does he propose that his readers may learn from water?

Those who have never tried to learn how much may be known about water, will be ignorant of a great many of its powers and properties and of the laws of nature which it illustrates; and consequently will be unable to account for many things of which the explanation is very easy. (19)

Huxley councils lay audiences repeatedly that from familiar elements of nature, such as water, they can learn a lot

about the universe.

Huxley applies the window technique in his working men's lectures. In the beginning of the six lectures, he proposes this approach to explain Darwinism:

I . . . take some ordinary animal with which you are all familiar, and, by easily comprehensible and obvious examples drawn from it . . . show what are the kind of problems which living beings in general lay before us; and I shall then show you that the same problems are laid open to us by all kinds of living beings. (CE 2: 305)

The animal or, the window, he selects here is a horse, through which he explains the anatomy, embryology, histology, and other scientific principles of the animal kingdom.

In the beginning of the second lecture, Huxley explains the history of nature and gives his audience a glimpse of the vision of this history:

We have . . . to deal with the facts of that history--a history involving periods of time before which our mere human records sink into utter insignificance--a history the variety and physical magnitude of whose events cannot even be foreshadowed by the history of human life and human phenomena--a history of the most varied and complex character. (2: 332)

The essay gradually unfolds this complex history and the

audience comes to learn about the past of the earth's slow, elemental change, its ceaseless alteration by unseen forces, and the growth of its many life forms. Using ordinary mud as a scientific window, he reveals this world vision to the audience.

Ordinary mud is a record of the past history of the earth. "The question which we have to investigate," says Huxley, "resolves itself into a question of the formation of mud" (2: 333). He further tells that "this inquiry . . . takes us to the very root and foundations of our subject" (2: 334), which is the past history of the earth. Many animals and plants--some extinct, some still thriving in the modern world--have left their imprints and fossil remains in the mud. Examining these records found in the mud, the audience comes to achieve a vision of the past. Thus, ordinary mud, in Huxley's hands, acquires almost a magical power to reveal the history of the earth.

Huxley uses the window technique in many of his popular essays. In the beginning of "On a Piece of Chalk," he tells his audience about the appropriateness of this topic and how he intends to use it:

After much deliberation, I have been unable to think of any topic which would so well enable me to lead you to see how solid is the foundation upon which some of the most startling conclusions of physical science rest (emphasis added). (CE 8: 4)

Huxley intends his topic to help him show the foundation of physical science. Using a piece of chalk as a window, he leads his audience to see this world.

Huxley himself refers to this address as "making the chalk tell us its own history" (8: 6). From the city of Norwich, he takes the audience imaginatively underneath the city and shows the great layer of chalk that extends north to Yorkshire, south to Dorset, links London to Paris, and runs through Europe and parts of Asia and Africa. He announces, "A great chapter of the history of the world is written in the chalk . . . which I hope to enable you to read, with your own eyes" (8: 4). He declares that a man should know the true history of the bit of chalk to have a clear conception of "this wonderful universe and of man's relation to it."

What is the history of the chalk? What does it reveal about the universe and man's relation to it? The chalk is an organic artifact composed of Globigerinae, radiolaria, and diatoms, the remains of which have formed vast deposits beneath the surface of the earth and under the ocean floor. From the time of the formation of the chalk to the present day, many changes had taken place, says Huxley, on the surface of the vast chalk deposit. The animal and plant kingdoms continue to evolve from the successive generations. The chalk itself has arisen and descended relative to the sea level at least four times. Land and oceans are merely conditions of time. As Ashforth points out, "In Huxley's

hands a piece of chalk was, therefore, invested with undreamed of significance" (59). Thus, through the "window" of chalk, Huxley presents a vision of the eternal process of time.

Like a piece of chalk and ordinary mud, Huxley uses a lump of coal in his "On the formation of Coal" to explain the complex formation of the mineral: how the beds of organic life were laid, depressed, combined with other sediments, and finally transformed into coal. Likewise, in his essay "Yeast," he makes use of the plant to survey the works of Lavoisier, Pasteur, and Robert Boyle in their efforts to analyze the properties of the plant. Huxley thus uses scientific windows as general illustrative tools through which he can show his audiences his vision of the world.

Commonplace and Local Examples

Presentation becomes an art to H.M. Boettinger, when a speaker appeals to his audiences' experience. If a speaker can relate his topic to the audiences' experience, they will quiver with response. The presentation of the topic, then, becomes an art (11). Audiences' experience, when they come to hear scientific exposition, consists of apparent bits and pieces of information that may be directly or indirectly relevant to the topic. In his scientific prose, Huxley frequently refers to his audiences' experience by means of illustrative techniques such as commonplace examples and

local examples.

The techniques function in two ways. First, they illustrate various scientific principles. They introduce, explain, and reinforce the scientific information Huxley is passing on to his audiences. Second, they relate science to the every-day occurrences and activities of life.

Discussing the use of literary devices in scientific prose, DeWitt Reddick points out that examples provide "a human experience which will enable the reader to relate himself to the article" (23). Huxley's examples do exactly the same. Common observations are shown as the interaction of various scientific principles. Common physiological functions are described as the result of various scientific principles. These examples help the audiences to become aware of their own physical bodies, their immediate environment, their own county, and their own country in relation to the universe and life in general. Let me discuss how Huxley uses these examples and how they are significant in his popularization of science.

First, let me analyze Huxley's use of common place examples. Besides illustrating a scientific concept, these examples help the audiences become knowledgeable about the way science has become interwoven with their own lives.

Commonplace Examples

Huxley believed that knowledge of nature could be gained by direct observation and experiment and that for

these the ordinary things around us provided ample material. Late in this century, Houp and Pearsall echoed the same when they told writers to use their imagination to pick up innumerable simple things that are familiar to readers (25-26). Jumping into water is a common occurrence. Most people have fallen into water from a height and experienced pain on hitting it. Huxley uses this experience to illustrate the property of resistance: "Any one who falls from a height into water will find that he receives a severe shock when he reaches it" (Science Primer 20). The example adds a concrete dimension to the abstract principle.

While praising Huxley on this count, James Paradis observes, "Abstract concepts are continually made visual for the audience, traced to their manifestations in the concrete patterns of daily existence" (41). Note how Huxley traces an abstract idea to a "concrete pattern" of daily experience: Water molecules have greater cohesive force and hence assume a spherical shape as manifested in water droplets. After explaining the concept, he relates the phenomenon to readers' familiar observation of water droplets that have formed upon cabbage leaves and grass blades after heavy dew (Science Primer 22). Using this reinforcement of scientific concepts through commonly observable patterns of life, Huxley makes the exposition meaningful to the audience.

In "On a Piece of Chalk," Huxley shows the wide-spread occurrence of the substance carbonate of lime. He tells the

workers that the substance is nothing but the various types of limestones with which they are familiar. There is hardly anything more ordinary than limestones to illustrate the occurrence of lime stones. Huxley tells his audience, "The fur on the inside of a tea-kettle is carbonate of lime" (CE 8: 6).

In "Biogenesis and Abiogenesis," Huxley points to the common experience of his readers to illustrate that food provides easy ground for the growth of minute organic life. Barbara Gastel, while discussing the methods to be used in communicating with the public, observes, "After presenting a general concept, you can support and clarify your ideas in various ways. One effective technique is to use examples" (6). Huxley's examples in this case suggest the same kind of use. To support the concept that food harbors minute organic life, he lists the following examples: Food is often covered with mould. Fruits contain grubs at the core. Meat putrifies and harbors swarms of maggots. Ordinary water, standing still in an open vessel, soon becomes turbid and full of living matter.

To illustrate that plants are fatally infected with microorganisms, Huxley lists the most commonly observable plant diseases such as the smut of wheat, the grape disease, and the potato diseases. To illustrate that even small insects cannot avoid such attacks, he draws the readers' attention to a familiar observation: flies sitting motionless upon a window-pane with a white circle drawn

round them. Then, he explains how this white circle is a sign of a fungal attack on the flies.

In his working men's lecture, Huxley explains the concept of variation. A child inherits some characteristics of the male parent and some of the female parent, but differ from both in some characteristics. To reinforce this concept to the workers, he says, "That must be quite plain to all of you who have looked at all attentively on your own children or those of your neighbours" (CE 2: 399). Then, using this example, he proceeds to explain degrees of variation possible in the sexual propagation of animals. Paradis refers to the use of this technique as an attempt to establish "democracy of knowledge" because Huxley's working men's lectures are "consistently woven around the common objects of experience" (40).

Huxley adopts the same method of relating science to the daily observation of his readers in his book Physiography. What happens to rain water that falls upon dry ground? Huxley reminds his students of the familiar observation of water falling on hard rock. This water runs in all directions, finally joining the river nearby. Some lodges into the crevices of rocks and slowly dries up. From this perceptible phenomenon, he moves on to tell his students what happens to the rain water that sinks unseen into the ground. Thus he completes the information by linking what the readers can easily perceive to what they cannot.

In another instance, to explain that water increases in volume when it solidifies, Huxley refers his readers to a common experience in winter: Water pipes bursting during a frost. Again, he points out to his readers a very common activity and then introduces a related scientific concept. He tells them,

The damp towel on which you have just wiped your wet hands does not stand long on the towel-horse before it becomes dry again; the water left forgotten in the flower-vase a week ago has completely dried away. (67)

Using these ordinary activities, he explains the phenomenon of evaporation in detail.

Local Examples

Like ordinary examples, Huxley also chooses local, geographical examples to illustrate his points. The local examples help readers become aware of their surroundings. The significance of local examples can be traced to his principles of teaching students. In Physiography, he notes,

I do not think that a description of the earth, which commences, by telling a child that it is an oblate spheroid, moving round the sun in an elliptical orbit; and ends, without giving him the slightest hint towards understanding the ordnance map of his own county; or any suggestion as to the meaning of the phenomena offered by the brook

which runs through his village, or the gravel pit whence the roads are mended; is calculated either to interest or to instruct. (vii)

Through the local phenomenon, students are able to gain a perspective on the universe. With the help of the local phenomenon, a learner may proceed to understand the cause behind it, and another, "until, step by step, the conviction dawns upon the learner that, to attain even an elementary conception of what goes on in his parish, he must know something about the universe (vii-viii). Thus, to know the local phenomenon is to know the universal phenomena, and Huxley's writings, both for students and for lay audiences, are full of such referenes.

In New York City Huxley gave lectures on evolution, which contain many local references. To illustrate that specific forms of life continue to live without change, he draws the audience's attention to Niagara Falls: "A remarkable case is to be found in your own country, in the neighbourhood of the falls of Niagara" (American Addresses 34). He points out that the shells preserved in this region are similar to those of certain contemporary species.

In another instance, to illustrate that the horse species must have originated in America, Huxley refers to the works of Professor O.C. Marsh, the American geologist: "The investigations of American geologists have proved that the remains of horses occur in the most superficial deposits of both North and South America" (85). Also, he refers to

the fossil collection he had visited: "I have had the advantage of glancing over the collections in Yale Museum" (86). Such references bring scientific concepts from the usually distant and strange land of scientists to the neighborhood of readers. When scientific concepts are explained in terms of evidence found in the reader's locality, the concepts become more meaningful to them. The readers would be more interested in knowing what is happening in the neighborhood or what the evidence in the neighborhood proves.

In his own country, at the Philosophical Institute, Bradford, Huxley gave the lecture entitled "On the Formation of Coal." In explaining the structure of coal and how it is formed, he continuously reminds the audience of the coal bed near Bradford and its neighborhood. One type of coal structure is exhibited in the anthracitic or stone-coals. The other type is expressed by a certain kind of coal called "the 'Better-Bed' coal of the neighbourhood of Bradford" (CE 8: 139). Also, while describing the bed of coal, he refers his audience to the coal beds of South Wales and Nova Scotia (8: 147).

Unlike coal, chalk is very wide-spread, and in his lecture "On a Piece of Chalk," Huxley directs the audience of Norwich city to look around the city and in "the whole county of Norfolk, to Yorkshire in the North; to Dorset in the West; to the Isle of Wight; to the shores of Kent" (8: 1-2). To illustrate that chalk is older than clay, he

directs his audience's attention to the nearby coast of Norfolk: "You need go no further than your own sea-board for evidence of this fact" (8: 25). To illustrate that chalk is older than mankind, he tells his audience, "You have, within the limits of your own county, proof that the chalk can justly claim a very much greater antiquity than even the oldest physical traces of mankind" (8: 27-28). As he wrote in Physiography, he believed that observation of local phenomenon would provide firmness for and reality to any scientific conception (vii). The use of local examples are good illustrative techniques to point out the reality of scientific concepts.

Figures of Speech

Scientists and lay audiences see two different worlds. To lay audiences, the world consists of things that they can see, hear, and experience. The scientists' world extends beyond the perceptible world into an abstract world of theories and principles, and forces that govern the perceptible world. As Reddick says, they are "likely to have different views of what is 'the real world' " (13).

When scientists speak about the abstract world, without concern for lay audiences, communication totally breaks down. This failure will frustrate any speaker who uses only abstract terms. To overcome this possibility, George Campbell suggests that speakers appeal to audiences' imagination by presenting abstract ideas vividly (208). In

order to do so, they may use appropriate rhetorical tools, which connect the world of scientists with that of lay audiences.

Use of Figures to Illustrate

His Philosophy

Michael Halloran and Annette Narris Bradford point out that tools such as metaphors are very useful for scientists in the formulation and communication of scientific ideas (180). Huxley's prose is, as Blinderman says, full of such devices ("Semantic Aspects" 177). Huxley uses similes and metaphors to explain his philosophy of Nature and Science and to explain scientific concepts.

Huxley often lamented the public's ignorance of even the basic matters of life. He believed that even many educated people were not aware of the elementary facts of the physiological functions of the human body. In "On the Educational Value of the Natural History Sciences," at St. Martin's Hall in 1854, he exclaimed,

I am addressing, I imagine, an audience of educated persons; and yet I dare venture to assert that . . . there is not one who could tell me what is the meaning and use of an act which he performs a score of times every minute, and whose suspension would involve his immediate death;--I mean the act of breathing. (CE 3: 60)

In many of his lectures, he regretted the people's ignorance

of even the simplest laws of nature.

Nature, says Huxley, governs the life on the earth with its own laws. It rewards man when he understands and does not violate its laws. By contrast, it punishes him if he fails to understand or violates its laws. Huxley explains his view of nature through a chess metaphor. In "A Liberal Education; and Where to Find It," he asks the workers to assume that if success in life depends on winning a game of chess, would not they learn at least the names and the moves of the pieces? But nature and life are more complex and complicated than a game of chess. He tells the workers that their lives, fortune, and happiness "depend upon our knowing something of the rules of a game infinitely more difficult and complicated than chess" (CE 3: 82).

How complicated is the world of nature? What will happen to a man who does not know the laws of it? What happens to a man who knows and obeys the laws of it? Answers to these questions formulate Huxley's view of the world. Huxley expands the metaphor to explain his view of nature:

It is a game which has been played for untold ages, everyman and woman of us being one of the two players in a game of his or her own. The chess-board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of Nature. The player on the other side is hidden from us. We know that

his play is always fair, just and patient. But also we know to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance. To the man who plays well, the highest stakes are paid, with that sort of overflowing generosity with which the strong shows delight in strength. And one who plays ill is checkmated-- without haste, but without remorse. (3: 82)

Hence, to know the rules of nature is important for everybody to live happily in this world. But how can the lay audiences come to understand the laws?

Science is the answer. Scientific reasoning provides the means to understand the laws of nature. But not long ago science was accused of being a black art. Many considered science beyond their realm of comprehension. Throughout his life, Huxley told lay audiences that science is a matter of common sense, not a black art, and is within everyone's reach:

Science is perfected common sense. Scientific reasoning is simply very careful common reasoning, and common knowledge grows into scientific knowledge as it becomes more and more exact and complete. (Science Primer 18-19)

Stressing the need for learning the laws of nature, Huxley points out in this book that science is the necessary method for learning the laws.

In many of his essays, Huxley uses the metaphor that

science is common sense. In "On the Educational Value of the Natural History Sciences," he reiterates: "Science is, I believe, nothing but trained and organised common sense, differing from the latter only as a veteran may differ from a raw recruit" (CE 3: 45). Next he uses many similes to illustrate the similarities between common sense and the scientific method. The scientific method is like wielding a polished and pointed sword, whereas common sense is like a savage's hewing and poking with a club. In a sense, the use of the sword is a highly developed and perfected use of the club.

Science is common sense and scientific method is sophisticated common sense. Are scientists like common people? Huxley uses many analogies to highlight the similarities between the two. He shows the audience that scientists possess no mystical faculties. Their mental processes are "practised by everyone of us, in the humblest and the meanest affairs of life" (3: 45). To illustrate the resemblance between a scientist and a common man, Huxley uses an analogy:

A detective policeman discovers a burglar from the marks made by his shoe, by a mental process identical with that by which Cuvier restored the extinct animals of Montmartre from fragments of their bones. Nor does that process of induction and detection by which a lady, finding a stain of a peculiar kind upon her dress, concludes that

somebody has upset the inkstand thereon, differ in anyway, in kind from that by which Adams and Leverrier discovered a new planet. (45-46)

Huxley is able to communicate the basic similarity in the mental faculty between the two through analogies such as this one.

In his six lectures to the working men, Huxley reiterates that scientific investigation is not some kind of black art; instead, it is the expression of the necessary mode of working of the human mind (CE 2: 361-63). Again, he uses an analogy to illustrate the similarities between the mental operations of a scientist and those of an ordinary person. A baker or a butcher weighs out his goods in common scales, whereas a chemist, while performing a difficult and complex analysis, weighs the substance in his balance using finely-graduated weights. Huxley says,

It is not that the action of the scales in the one case, and the balance in the other, differ in the principles of their construction or manner of working; but the beam of one is set on an infinitely finer axis than the other, and of course turns by the addition of a much smaller weight. (2: 363-64)

But the basic method of operation is the same in both the cases. Proving that the reasoning process operates similarly in both, Huxley wants the lay audiences to accept his view that they should become scientifically aware of the

world around them. In order to do so, he depends upon many stylistic devices such as similes and metaphors.

To Illustrate Scientific Concepts

Huxley uses many similes and metaphors in his popular essays not only to convey his philosophy but also specific scientific concepts. In "Yeast," he compares sugar to soldiers. During the fermentation of sugar, sugar does not disappear but only rearranges itself in different forms. To illustrate this point, Huxley compares the sugar molecules to the soldiers of a brigade. The sugar molecules are, he says,

like the soldiers of a brigade who at the word of command divide themselves into the independent regiments to which they belong. The brigade is sugar, the regiments are carbonic acid, succinic acid, alcohol, and glycerine. (CE 8: 119)

The dissolution of sugar into its constituent elements is a chemical process that readers cannot see. In order to make the process perceptible to his readers, Huxley uses this simile of a brigade and regiments. By associating the chemical process with the regiments, Huxley is able to convey the abstract scientific idea vividly to his audience.

In another instance, Huxley compares sugar to a house of cards. The plant yeast ferments sugar into its various elements. But how does it actually do it? Three different hypotheses at the beginning of the nineteenth century

explained the phenomenon. Stahl propounded the notion that yeast in the solution of sugar is in a state of internal motion and communicates that motion to the sugar and causes its resolution into new substances. Fabroni, the Italian chemist, explained that the carbon of the yeast unites with the oxygen of the sugar, giving rise to carbonic acid, while the sugar unites with the nitrogen of the yeast, producing a new substance. This substance decomposes by distillation and gives rise to alcohol. Thenard propounded a third view, which stated that the carbon of the yeast combines with the oxygen of the sugar to form carbonic acid. In this process it disturbs the equilibrium between the constituents of the sugar, causing it to recombine afresh to form carbonic acid and alcohol (8: 123-24).

All three hypotheses explain the invisible forces that react in the fermentation process. To differentiate among these three views, Huxley uses an analogy:

According to Stahl, the ferment is somebody who knocks the table, and shakes the card-house down; according to Fabroni, the ferment takes out some cards, but puts others in their places; according to Thenard, the ferment simply takes a card out of the bottom story, the result of which is that all the others fall. (8: 124)

In this analogy, the yeast plant and sugar solution are personified. Sugar solution is a card-house sitting on a table and the yeast plant is somebody who knocks down the

card-house. The three methods of "knocking down" help the lay audiences to understand the basic differences among the three hypotheses.

In "The Progress of Science," Huxley explains the process of double decomposition by using salt as an example. The neutral salt is composed of acidic and basic molecules. One can replace the acidic molecules with other acidic molecules or the basic molecules with other basic molecules without altering the neutrality of the salt. Huxley compares the molecular structure of the salt to a cube of bricks:

A cube of bricks remains a cube so long as any brick that is taken out is replaced by another of the same shape and dimensions whatever its weight or other properties may be. (CE 1: 72).

In a cube of bricks, one may remove one brick from the cube and insert another one of the same dimensions. The structure of the cube does not change. The new brick that he used to replace may be of different weight or have other different characteristics. But as long as the two bricks are similar in dimensions, the structure of the cube will remain the same. The neutrality of salt is an abstract concept that lay audiences can not understand. By using a simile, Huxley adds a perceptible dimension to the complex scientific concept. The audiences not only understand the concept, but they will also remember it because of the simile.

Huxley uses similes in all of his popular essays. In "On the Physical Basis of Life," he compares the protoplasmic contractility of the nettle hair to the billows of a corn field:

Local contractions of the whole thickness of its substance pass slowly and gradually from point to point, and give rise to the appearance of progressive waves, just as the bending of successive stalks of corn by a breeze produces the apparant billows of a cornfield. (CE 1: 135)

In Science Primer, he explains how the two scales of a balance neutralize one another when equal weights have been placed on each of them:

It comes to the same thing, as if two boys of equal strength were pulling against one another; so long as the pulls in opposite directions are equal, of course neither boy can stir; while the smallest addition of strength to one enables him to pull the other over. (30)

In the same book, to explain the energy of moving water which is urged forward by momentum and pulled backward by gravitation, he uses another simile:

The case is similar to that of a boy sculling a boat, the bows of which are suddenly seized and the boat thrust violently backwards by a strong man. The boat will go stern-foremost rapidly, at first, but every stroke of the boy's oar at the

stern will retard its backward motion; until, at length the stock of momentum conferred upon it by the man's thrust will be completely exhausted in working against the boy, and the boat, after a momentary rest, will resume its onward course.

(44-45)

All these similes evoke vivid images in the minds of the lay audience. The billowing of a corn field, the tug of war between boys, and the momentum of a boat are the concrete representations of the abstract phenomena he is trying to explain. The audiences might not know or remember minute or complex technical details of these phenomena. But they could grasp and retain some basic ideas about these concepts--and that is what Huxley wanted his audiences to understand.

Any new knowledge must be integrated into the existing fund of personal and human knowledge possessed by a lay audience. If a popularizer relates to the experience of a lay audience, he will be able to communicate his subject readily to it. Illustrative techniques, such as examples or other rhetorical devices, help him to achieve the goal of clear, interesting exposition. In addition to these devices, many more devices are available to him; I shall discuss two such devices in the next chapter.

CHAPTER VI

STYLISTIC ADAPTATIONS II

Peopling Passages, or Human Interest

While analyzing the characteristics of lay readers, Houp and Pearsall point out that these readers are interested in other human beings and their personalities and that human drama and interest motivate them to accept a subject matter (22-23). The human element or interest is another stylistic device Huxley often uses in his popular essays. When popularizing, authors deal with complex scientific ideas, and general readers, who are not used to reading abstract concepts, may lose interest in the ideas. So it is up to the popularizers to make their subject not only informative but also interesting to the general readers. Often they accomplish this goal by bringing human characters to their essays.

The presence of human beings, their aspirations, their struggles to achieve them, their successes, failures, and emotions sustain readers' attention in Huxley's essays. If these human beings are scientists, readers may see the scientists in a different light and find that scientists are like themselves. This recognition could help them read about scientists and their actions with interest. Also,

when abstract scientific concepts are shown as affecting people, readers are well motivated to read the essays. In his scientific exposition, Huxley uses this human interest technique by peopling his prose with scientists, including himself, and with non-scientists.

Peopling Passages with Scientists

Huxley's popular prose is replete with accounts of many scientists, who come alive in his pages. They compete with each other to prove their theories, demonstrate experiments to readers, make mistakes, win or lose, and suffer at the hands of a hostile church. Huxley's readers not only read about various scientific theories but also learn about the scientists behind them.

In "Yeast," Huxley discusses the progress in the study of yeast, its nature, and its role in the fermentation process. Rather than merely explaining various scientific theories, Huxley dramatizes the progress made in the study of yeast by recreating the situations in which scientists compete with one another to prove their theories. He narrates the struggles of many scientists from the first half of the seventeenth century. In 1789 the French chemist Lavoisier thought he had demonstrated clearly the changes that take place in the fermentation process. He was wrong. In 1860, the French scientist Pasteur proved that Lavoisier was not quite right. Huxley brings in more scientists at this point and the competition among the scientists grows

more intense. In the same year the Dutch naturalist Leeuwenhoek discovered that yeast consists of globules floating in a fluid, and he thought that the globules were merely the starchy particles rearranged. But the rearrangement of globules existed "only in the worthy Dutchman's imagination" (8: 121) because a century and half later, almost simultaneously, Cagniard de la Tour and his colleague Turpin of France and Schwann and Kützing of Germany found these globules to be living organisms called torula.

A short time after Cagniard had discovered the yeast plant and the torula in it that ferments sugar, the German chemist Liebig treated Tour's discovery "with no small contempt, and, from that time to the present," says Huxley, "has steadily repudiated the notion" (8: 123) that the fermentation of sugar is due to the activity of torula.

How does yeast effect the changes in sugar? Huxley does not provide the answer directly; instead, he recreates the clashes between the scientists in finding an answer to the question, and the readers come to learn the answer directly from the scientists themselves. Stahl and Lavoisier took almost similar views. Fabroni held a different view. In 1803, Thenard, declaring that "I do not believe with Lavoisier," propounded a third view. In this manner Huxley brings more and more scientists to his pages and lets them take one side or the other, propounding and countering arguments.

In "Biogenesis and Abiogenesis," Huxley portrays another battle. The Italian naturalist Francesco Redi propounded the hypothesis of biogenesis (that life springs from pre-existing forms) against the theory of abiogenesis (that life springs from the dead) as it was popularly believed until the seventeenth century. As he does in "Yeast," Huxley portrays the battle of scientists in this essay, too. In the middle of the eighteenth century, Needham and the French naturalist Buffon challenged the findings of Redi, but Abbe Spallanzani, the Italian scientist and a successor of Redi, furnished "a crushing reply" to the findings of Needham (8: 245). However, "the advance of science soon showed that though Needham might be quite wrong, it did not follow that Spallanzani was quite right" (245). And so "the battle had to be fought again" (246). Thus, various scientific principles, as they were being formulated, are shown to be the result of the competition among scientists.

In appropriate situations, Huxley introduces in his exposition the human emotions and suffering of scientists to let his lay readers see the human side of scientists, which add an interesting dimension to the otherwise technical exposition of some scientific concepts. For instance, in his "Six Lectures," Huxley narrates the efforts of many scientists toward solving the question of spontaneous generation, which means that dead animal or vegetable matter on decomposition gives rise to insect life. A piece of meat

left in the sun and allowed to putrefy very soon harbors microorganisms growing in it. Huxley explains the phenomenon by recreating the competition of scientists. Many scientists in the seventeenth and eighteenth centuries believed that the meat had the power of spontaneous generation. Redi, the Italian naturalist, disproved this theory by showing that the grubs hatched in the sun from the eggs deposited in the meat by insects. Later on, when the discovery and the application of the microscope to scientific studies came into vogue, scientists discovered many microorganisms in the decomposing meat and revived the theory of spontaneous generation. To disprove this revived theory, the German physiologist Schwaan tried to show that little minute spores are always floating in the atmosphere, and they spring forth into life under proper conditions. But he could not prove his theory. The experiment he conducted "puzzled him altogether." Indeed, his experiment proved the spontaneous generation theory "to his great dismay and discomfiture" (2: 384-86).

While explaining biogenesis, Huxley tells the readers the feelings of the scientists who had to battle with the Church and suffer the consequences. Redi, for his theory against abiogenesis, "did not escape the customary tax upon a discoverer of having to defend himself against the charge of impugning the authority of Scriptures." "Against all odds, however," declares Huxley, "Redi, strong with the strength of demonstrable fact, did splendid battle for

Biogenesis" (8: 236-37). Similarly, in the essay on Descartes, Huxley reminds the readers of the suffering of Galileo at the hands of the Church:

It is not pleasant to think of the immediate result of the combat; to see the champion of science, old, worn, and on his knees before the Cardinal Inquisitor, signing his name to what he knew to be a lie. And, no doubt, the Cardinals rubbed their hands as they thought how well they had silenced and discredited their adversary. (1: 180)

In this essay, where he discusses the philosophy of Descartes, Huxley never fails to bring Descartes' mortal suffering and problems to the readers:

His books narrowly escaped being burned by the hangman; the fate of Vanini was dangled before his eyes; and the misfortunes of Galileo so alarmed him, that he well-nigh renounced the pursuits by which the world has so greatly benefitted, and was driven into subterfuges and evasions which were not worthy of him. (1: 196)

Descartes is analyzed as a man rather than a scientist here. Huxley accepts that his readers might view Descartes' action as "cowardly." But he argues that in the seventeenth century heresy meant possible burning or imprisonment. A mere suspicion would destroy a man's peaceful pursuit. Hence, Huxley says,

Descartes was a man to care more about being worried and disturbed, than about being burned outright; and, like many other men, sacrificed for the sake of peace and quietness, what he would have stubbornly maintained against downright violence" (1: 197).

The mortal sufferings of scientists add a dramatic effect and therefore interest to the essays such as this one, which would otherwise have been a "mundane" explanation of "some abstract philosophy" to general readers.

Sometimes, while explaining scientific theories, Huxley portrays the hard work that scientists had to do to accomplish something. For instance, when he describes the structure of Heteromita, the microscopic organism, in "On the Border Territory between the Animal and the Vegetable Kingdoms," Huxley talks about the scientists Dallinger and Drysdale, who studied these organisms fully:

These most patient and painstaking observers, who employed the highest attainable powers of the microscope and, relieving one another, kept watch day and night over the same individual monads, have been enabled to trace out the whole history of their Heteromita. (CE 8: 180)

The description of the scientists' struggles in their attempts to establish a theory reveals the "human" side of them, making the subject lively and evoking readers' unhindered attention to it.

Sometimes, while recapturing the actual moments of an experiment, Huxley lets the scientist engage in a soliloquy. In "Six Lectures," where he describes Pasteur's experiment to disprove the spontaneous germ theory, he imaginatively reconstructs the step-by-step procedure by which Pasteur made this experiment. Readers can see Pasteur moving across and carrying on the experiment, and hear him talk to himself:

If my view is right, and if, in point of fact, all these appearances of spontaneous generation are altogether due to the falling of minute germs suspended in the atmosphere,--why, I ought not only to be able to show the germs, but I ought to be able to catch and sow them, and produce the resulting organisms. (CE 2: 387)

Then, the readers see Pasteur doing his experiments meticulously, listen to his contemplation, and again watch him carry out another set of experiments.

Likewise, in "Biogenesis and Abiogenesis," Huxley recreates imaginatively the scene so that his readers can see Redi carrying out his experiments, contemplating and loudly commenting on his work to disprove spontaneous generation. For instance, pointing to the dead animals or pieces of meat, Redi says,

I expose them to the air in hot weather, and in a few days they swarm with maggots. You tell me that these are generated in the dead flesh; but if I

put similar bodies, while quite fresh, into a jar,
not a maggot makes its appearance. (CE 8: 234)

By portraying the scientists as they are doing their experiments and creating what they might have said to themselves, Huxley recaptures the scientists' lives in his essays. The recreation of the actual situation and dramatization of it with monologues are usually appealing to general readers as they are likely to be motivated to read something that involves human elements.

The Presence of Huxley Himself in His Essays

In addition to seeing many scientists, Huxley's readers see the presence of Huxley himself in his essays. In his brief analysis of Huxley's style, James Paradis ascribes Huxley's success as a popularizer to the "projection of the self as the scientist" (38) in his essays. From Huxley's pages, he talks to his readers, portrays himself as an object of his experiment, meets other scientists, and acknowledges his inability to carry on some experiments.

In Science Primer, to explain that all things happening around us are the effects of definable causes, Huxley describes a hypothetical situation in which he is present as an observer himself. One day when it is raining and windy, Huxley looks out through a window. To take shelter from the rain, a man rushes under a tree and gets hurt as a

branch of the tree falls on him. Describing this situation, Huxley asks whether what happened to him is occurred by chance and accident or whether it has any clear cause (11). The hypothetical situation becomes interesting to readers because in it are the writer and another man engaged in their respective activities, and the activities are narrated as in a story.

In "On the Physical Basis of Life," Huxley uses himself as a model to demonstrate that the living protoplasm of the body loses part of its vigor in maintaining daily activities though it may be replenished by the addition of new sources of protoplasm to diet. Huxley explains this process by describing in various stages how his body uses the vital protoplasm in delivering the lecture and how he can replenish it by eating meat. He continues to trace the journey of the protoplasm by describing what will happen to it when he dies.

In the essay on lobster, the readers see Huxley demonstrating how to dissect a lobster. They see him dissect a part of the animal, listen to him explain the part, and watch him move on to the next step in the dissection-explanation process. Likewise, in the "Six Lectures," the readers can actually see Huxley holding up a visual in front of them and explaining certain parts of animals or plants. It is not difficult for any reader to visualize Huxley in his pages.

Sometimes, Huxley acknowledges his inability to find

out an answer to a question. In "Yeast," he narrates many scientists' efforts to connect torula, the microorganism present in the yeast plants, to the lower forms of plant life, but he says that could never do it: "I have never been able to trace the development of Torula into a true mould" (CE 8: 122).

In "On the Border Territory between the Animal and the Vegetable Kingdoms," Huxley describes his lack of time for investigating the nature of the microorganism Heteromita: "I have been unable to devote to my Heteromita the prolonged study needful to work out its whole history, which would involve weeks, or it may be months, of unremitting attention" (CE 8: 180).

In almost all his popular essays, Huxley reveals his personal conviction about matters of certain scientific doctrine, his unhappiness about the hue and cry of the Church against Science, his feelings of admiration for other scientists, and contempt for pretentious clergyman who talk about science. (I detailed such instances in the third chapter.)

Sometimes, Huxley describes his meetings with other scientists. In "On the Formation of Coal," he describes one such meeting with Sir John William Dawson, who was an expert in the fossil remains of the plains of North America:

When I had the pleasure of seeing principal Dawson in London last summer, I showed him my sections of coal, and begged him to reexamine some of the

American coals on his return to Canada with an eye to the presence of spores and sporangia, such as I was able to show him in our English and Scotch coals. (CE 8: 146)

In "On the Border Territory between the Animal and the Vegetable Kingdoms," he narrates the meeting between Tyndall and him:

Some months ago, Professor Tyndall asked me to examine a drop of infusion of hay placed under an excellent and powerful microscope, and to tell him what I thought some organisms visible in it were. (8: 177)

Huxley responded to Tyndall's request and humorously acknowledges Tyndall's reaction:

My friend received my verdict with an expression which showed a sad want of respect for authority. He would as soon believe that a sheep was a plant. Naturally piqued by this want of faith, I have thought a good deal over the matter. (8: 179)

The presence of Huxley, like that of the other scientists, makes his passages lively.

Peopling Passages with Non-Scientists

Besides Huxley and scores of scientists, many other non-scientists and common folks appear in his popular essays. These people witness phenomena of nature or scientific concepts. By showing that science is something

that touches every individual, Huxley creates a positive response in his readers, encouraging them to read his prose. Narration of the events in real people's lives helps Huxley convey his ideas quite effectively.

The living body is a mechanism. All physiological functions of the body can be explained in the same way as other physical phenomena. The living body sustains, reproduces, adjusts itself to external and internal changes, and moves and feels. Can a man perform all these operations mechanically, without the intervention of any consciousness? What happens to him when his brain is injured? How much of the usual functions will he be able to perform without consciousness? Huxley explains this phenomenon of animal automatism through an illustrative case of a frog. Then he moves on to explain the phenomenon through the case history of a French sergeant who was wounded and paralyzed during the battle of Bazeilles in 1847. When he recovered, his life was not the same again. His brain was apparently uninjured but his life had been divided into alternating phases of short abnormal states and longer normal states. By narrating the normal and the abnormal states of the sergeant, Huxley recreates the life of this man for his readers to see and understand the scientific concept of animal automatism.

In another instance, Huxley explains the theory of the struggle for existence using an analogy from the famous retreat of Napoleon from Moscow. In nature every species of

plants and animals must fight its way through and struggle with other species. In this struggle, the smallest chance may help the species survive. To illustrate this point, Huxley makes use of the historical event. On its retreat, the vast army reached the bridge of Beresina, which was too small for the army. Disorganized and demoralized as the army was, the men tried to cross the bridge, crushing through the ranks and treading upon each other. A soldier who later narrated this event noticed a strong French Cuirassier striding onward through the mass and clung to his large cloak. Unable to shake him off, the strong man dragged him through the bridge, thus helping the soldier in his escape. Using this analogy, he tells the audience in clear terms that "every species has its bridge of Beresina" and that the smallest chance such as something in the color of the species may help it survive over other species (2: 443).

When using the historical anecdote mentioned above only as an analogy, Huxley makes use of the following one as a case history to reinforce a point. For example, to illustrate nature's tendency to perpetuate a variation, he narrates the genealogy of a Maltese, who was born with six fingers on each of his hands and six toes on each of his feet. He begot both five- and six-fingered progeny. Also, the subsequent generations produced both the normal and the abnormal types (2: 404-408). By tracing the characteristics of the Maltese's offspring, Huxley makes it plain to readers

that variations acquired in one generation may be perpetuated in the following generations.

Likewise, in "Biogenesis and Abiogenesis," while explaining the infectious disease that caused the French silkworm industry disaster in 1853-68, Huxley relates the suffering of the people connected with the industry:

The Great number of people engaged in silk growing are some thirty millions sterling poorer than they might have been. . . . The cultivator has constantly seen his silk worms perish and himself plunged in ruin; . . . the looms of Lyons have lacked employment, and . . . for years, enforced idleness and misery have been the portion of a vast population which, in former days, was industrious and well-to-do (265-66).

Though Huxley's main aim is to discuss how the infectious disease broke out, and how it was controlled later on, he moves on to areas which would bring people and their suffering into the situation. As Thomas Sawyer emphasizes, "Facts and figures by themselves are not dramatic, people are" (7). Connecting the facts and figures of scientific information to the suffering of people, Huxley tries to interest readers in his prose.

Whenever possible, Huxley involves his readers in his prose by inviting them to join him in doing experiments. Instructed by Huxley as necessary, the readers observe local phenomena or familiar examples and understand certain

concepts. In short, they are present in the essay along with Huxley.

The essays are a learning process for Huxley's readers, who are involved in the learning activities described in the essays. Sometimes, they are there to receive instruction from Huxley:

If you put your finger into the water you can move it in all directions with scarcely any feeling of obstacles. If you pull your finger out there is no hole left, the water on all sides rushing together to fill up the space that was occupied by the finger. (Science Primer 21)

Sometimes, he creates hypothetical learning situations, introduces readers into them, and leads them to confront the problem and learn the principles on their own. For instance, in his "Six Lectures," he explains inductive and deductive reasoning by creating such hypothetical situations. Paradis describes this situation as the scientific method enacted between shop-keeper and customer (42). The processes of deductive and inductive reasoning, Huxley says, "are being used by yourselves every day and every hour of your lives" (CE 2: 364). So he creates a day of their lives and lets them live through it. In the hypothetical situation, he has his readers visit a fruit shop and select ripe apples and discard raw fruits:

Suppose you go into a fruiterer's shop, wanting an apple,--you take up one, and, on biting it, you

find it is sour; you look at it, and see that it is hard and green. You take up another one, and that too is hard, green, and sour. The shopman offers you a third; but before biting it, you examine it, and find that it is hard and green, and you immediately say that you will not have it, as it must be sour, like those that you have already tried. (2: 365)

The readers go through the syllogistic process of deducing that all hard and green apples are sour. Then Huxley introduces some more characters in the situation, who object to the readers' deduction. The rest of the description of the situation deals with how the readers prove to their friends the validity of their conclusion. In the end, he assures them that "the method of establishing laws in science is exactly the same as that pursued in common life," only more complete (2: 368).

Likewise, Huxley creates another hypothetical situation of burglary and lets his readers investigate it to determine whether it is a burglary or not. At the end of the description of the situation, referring to the common sense of the reasoning process, he comments,

Precisely the same mode of reasoning was employed by Newton and Laplace in their endeavours to discover and define the causes of the movements of the heavenly bodies, as you, with your own common sense, would employ to detect a burglar. (2: 373)

Involving readers in the situation reduces the distance between them and the abstract concept that they are trying to understand. The concept is no longer strange; it becomes meaningful to them when it is explained as something affecting them or that they are actually experiencing themselves.

Whether readers or scientists are presented, the human element makes scientific exposition less abstract, more meaningful, quite dramatic, and therefore interesting to lay readers.

Huxley's Language

The last striking feature of Huxley's scientific prose that I will discuss is his language. All his critics praise his style, as does Joseph H. Gardner, who says that Huxley's writings are "remarkable for their clarity, forcefulness, and grace of style" (177). Of the many stylistic devices that may contribute to this effect, I choose to describe Huxley's diction, which is simple and concrete.

Simple and Nontechnical Words

Huxley "strove to use the language of the market place," says Charles S. Blinderman, "when communicating ideas to people who frequented pubs" ("Semantic Aspects" 171). In his essay "On a Piece of Chalk," Huxley describes two experiments to prove that chalk is composed of carbonate of lime. Note how he replaces technical terms with ordinary

words in the following description of the oxidation of chalk:

We all know that if we "burn" chalk the result is quicklime. Chalk, in fact, is a compound of carbonic acid gas, and lime, and when you make it very hot the carbonic acid flies away and the lime is left. (CE 8: 5)

Note the words quick lime, burn, make it very hot, and flies. Quick lime is the commonplace word for calcium oxide. Burn is a nontechnical term that stands for the technical word decompose. Make it very hot is a simple substitution for a specific temperature range. Evolve is the technical term for flies. Again note how he describes the process:

If . . . you were to powder a little chalk and drop it into a good deal of strong vinegar, there would be a great bubbling and fizzing, and, finally, a clear liquid, in which no sign of chalk would appear. Here you see the carbonic acid in the bubbles; the lime, dissolved in the vinegar, vanishes from the sight. (8: 5)

Strong vinegar and bubbling and fizzing stand for acetic acid and effervescence respectively.

In order to popularize science, Huxley has to reach general audiences and use an appropriate language for them. The very beginning of the essay "On the Physical Basis of Life" reveals Huxley's concern for appropriate language:

In order to make the title of this discourse generally intelligible, I have translated the term "Protoplasm," which is the scientific name of the substance of which I am about to speak, by the words "the physical basis of life." (CE 1: 130)

His effort to make the title of the essay "intelligible" to his readers clearly indicates that his language is influenced by his awareness of audience. Also, when he says that he translated the term protoplasm by the words the physical basis of life, he indicates that he is going to use common terminology in the place of scientific terms.

Huxley's graphic description of the cell of a nettle hair is a fine example of the nontechnical language he uses in this essay:

The whole hair consists of a very delicate outer case of wood, closely applied to the inner surface of which is a layer of semi-fluid matter, full of innumerable granules of extreme minuteness. (1: 135)

In this description, he carefully avoids all technical terms a writer would normally use to describe the structure of a cell. What follows is a list of nontechnical terms Huxley used in the above passage and their equivalent technical terms (source of the technical terms: Dittmer 61-65):

Nontechnical Terms

outer case of wood

semifluid matter

granules of extreme

minuteness

Technical Terms

cell wall

mucilagenous and

viscous mass

organelles As Chalmers

Mitchell points out, Huxley had of necessity "the wide and varied vocabulary of the natural and technical sciences at his disposal" (214). Technical terms like cell wall and organelles are not new to him; however, in the description of the cell, he prefers common terminology because it is appropriate for his general audience.

In yet another place, Huxley talks about the granular movement of protoplasm: "The granules are driven in relatively rapid streams through channels in the protoplasm which seem to have a considerable amount of persistence" (1: 135). Protoplasmic channels are technically referred to as endoplasmic reticulum, a term that certainly was in the "wide and varied vocabulary" of Huxley. However, he shuns using technical terms. Sometimes, his preference for commonplace words forces him to describe a phenomenon with far more words than would be required had he used the precise technical terms. For instance, when he refers to the granular movement in the cell, he discusses the two types of protoplasmic current:

Most commonly the currents in adjacent parts of the protoplasm take similar directions; and, thus

there is a general stream up one side of the hair and down the other. But this does not prevent the existence of partial currents which take different routes; and sometimes trains of granules may be seen crossing swiftly in opposite directions. (1: 135-36)

For the technical audience, the entire description could be summed up in a few words such as "the circulatory and rotational streaming of protoplasm" (source: Peter Bell and David Coombe 284). However, cumbersome though it may be, Huxley uses only nontechnical words here to keep his language within the comprehension of his general audience.

Concrete Words

As Paradis points out, Huxley uses the "the simplest and most concrete language" (40). Concrete words project vividly the examples and analogies he includes in his essays. They add more detail to examples and analogies and thus help readers comprehend scientific matter easily. First, let us see how Huxley enriches his examples with concrete words. In "On the Physical Basis of Life," he tells his readers that "there is some one kind of matter which is common to all living beings, and that their endless diversities are bound together by a physical unity" (CE 1: 131). In order to explain this abstract concept, first he exemplifies two entirely different beings:

What community of faculty can there be between the

brightly-coloured lichen, which so nearly resembles a mere mineral incrustation of the bare rock on which it grows, and the painter, to whom it is instinct with beauty or the botanist, whom it feeds with knowledge? (1: 131)

The examples "lichen" on one hand and "painter" and "botanist" on the other hand represent the extreme structural variations among living beings. General readers may not have any difficulty in understanding the extremes represented by the painter and the botanist, but they may not so easily understand the other extremity represented by the lichen. Not many general readers could visualize a lichen at first reading. Hence, Huxley adds more visual details to the word lichen by choosing concrete words. The adjectival phrase brightly coloured and the noun phrase mineral incrustation of the bare rock add more visual qualities to the word lichen so that the readers can actually perceive the plant.

Likewise, to state that the same material composition is seen in all species, Huxley introduces examples of different species: "What is there in common between the dense and resisting mass of the oak, or the strong fabric of the tortoise, and those broad disks of glassy jelly?" (132) Each example is composed of concrete words. Nouns like oak, tortoise, and jelly are by themselves concrete words. However, Huxley adds more descriptive details to each one of the examples using concrete words. The phrases dense and

resisting mass, strong fabric, broad disk, and glassy help readers picture these examples themselves.

In "On a Piece of Chalk," Huxley describes the process of the land surface sinking to the bottom of the rising sea:

That dry land, with the bones and teeth of generations of long-lived elephants, hidden away among the gnarled roots and dry leaves of its ancient trees, sank gradually to the bottom of the icy sea, which covered it with huge masses of drift and boulder clay. (CE 8: 27)

The terms used to create the contrasting images of dry land and icy sea, and the concrete nouns used to describe what is beneath the land--bones, teeth, roots, leaves, trees--evoke vivid images in readers' minds. This descriptive style of Huxley, as Aldous Huxley comments, "does what it was intended to do--gives the reader a satisfyingly accurate picture of what is being described" (68).

The two techniques, the use of the human element and simple language, significantly contribute to the success of Huxley's popularization. The human element, while dramatizing scientific concepts, makes his prose interesting to lay readers. Simple and concrete words translate complex and technical concepts into a language that is comprehensible to general readers.

CHAPTER VII

CONCLUSION: REASONS FOR SUCCESS

In ancient rome, throwing Christians to lions was a favorite pastime. Once, a particular Christian was thrown to a lion. The lion grabbed him by the shoulders, threw him to the ground, and suddenly walked away and went to sleep. The Christian got up rubbing his shoulder and walked back into the cells in the coliseum. The other Christians gathered around and asked him, "How did you do that?" "It is simple," he replied, "I whispered into the lion's ear that 'after the meal, you will be expected to make a few remarks.'" Apparently making a speech has never been easy, be it a relaxed after-dinner speech or a well-rehearsed scientific lecture in front of a lay audience. Difficulties in making speeches are as significant as the difficulties in writing essays.

Huxley had to confront the difficulty very early in his popularizing career. After his lecture for the British Association for the Advancement of Science in 1851, Huxley received two letters of warning and remonstrance, as outlined in his Life and Letters, 1, against the habits of lecturing in a colloquial tone, running his words together, and pouring out new and unfamiliar matter at breakneck speed (94-95).

From the nervous, shaky beginning, Huxley grew into one of the great popularizers of the nineteenth century. An analysis of the reasons for his success will be valuable to contemporary writers interested in popularizing in particular or to anyone interested in communication in general.

The reasons for Huxley's success as a popularizer are mostly related to the techniques he uses in his popular essays. Of them, the most significant one is his awareness of audience, which is basic to formulate various techniques that are helpful in reaching lay audiences.

For any communication attempt to be successful, writers must know all about their audiences. Huxley was successful in his popularizing because he understood his audiences very well. However, this understanding did not come easy to him. On receiving a gold medal from the Royal Society for his scientific contributions to the Society, he made an Anniversary Dinner speech in 1852. In 1848 when he was exploring the marine lives on the H.M.S. Rattlesnake, he had sent papers for publication and did not hear about it until he returned to England two years after. During the two years on board the ship, he was despairing about the fate of the papers and eventually his career in science. However, when he returned to England from the voyage, he came to know that the papers gained him a bright place in the scientists' circle.

In his Royal Society speech, Huxley wanted to explain

eloquently his waiting and despair aboard the H.M.S. Rattlesnake by using a simile, anticipating his audience's applause. The following letter to his sister describes his initial attempts to study the audience:

In the speech I had to make at the Anniversary Dinner I grew quite eloquent on that point, and talked of the dove I had sent from my ark, returning, not with the olive branch, but with a sprig of the bay and a fruit from the garden of the Hesperides--a simile which I thought decidedly clever, but which the audience--distinguished audience I ought to have said--probably didn't, as they did not applaud that, while they did some things I said which were incomparably more stupid.

(L. Huxley 1: 114)

However, with time and practice, Huxley became more aware of the disparate audiences he was communicating with. His essays and his comments outside the essays indicate his awareness of his audiences' background. As Philip Abelson, the editor of Science in 1976, points out, "In general people who cannot or do not customarily analyze and respond to the needs of others cannot communicate" (565). Without an awareness and a possible profile of the audiences, writers can never successfully plan to reach them.

Planning involves adapting content and style to audiences. A brief summary of Huxley's adaptation strategies would be helpful to scientific and technical

writers who write about complex, space-age technology to lay people. Whether it is an essay or a series of lectures, Huxley's subject to the lay audiences was always complex. He divides the complex matter into small units of easily comprehensible information. He treats each unit as a mini-essay, having its own beginning, middle, and end. The units are independent of each other, yet they collectively contribute to the total meaning of an essay. He excludes all technical and complex details, providing only the basics of the subject matter.

Though Huxley treats a subject matter at the basic level, he relates it to other relevant subjects. Because the subject matter is scientific and new to popular audiences, he needs to familiarize them with all relevant aspects of the subject. Therefore, his addresses are often very comprehensive, encompassing many related fields of study.

Finally, as a content adaptation strategy, Huxley refers to current issues of interest to the lay audiences. He avoids references to any social issues to expert or student audiences but combines plain facts of scientific exposition with his personal views when he addresses the lay audiences. The extraneous but relevant-to-the-subject issues make popularization interesting to lay people because they usually want to know the opinions of experts on the issues.

Besides content adaptation, Huxley's stylistic changes

are useful techniques for scientific writers. His popularizing method, which can be called exposition by illustration, works at two levels. On a broad level, the illustrative technique functions as a scientific window offering the audience a large vision of nature that is composed apparently of a chaotic maze of the principles and the operation of nature's laws. Huxley uses common physical entities such as coal and chalk, but an exposition of them sheds light on the general principles of science.

On a specific level, the illustrative technique relates science to the common, everyday experience of lay people using ordinary and local examples. These examples illustrate various scientific principles and make scientific exposition meaningful as well as interesting to lay audiences. Scientific and technical writers may use the technique to introduce, explain, and reinforce complex subject matter that they have to share with lay audiences. Huxley describes, for instance the common physiological functions as the result of various scientific principles. These examples help the audiences become aware of their own physical bodies, their immediate environment, their own county, and their own country in relation to the universe and life in general.

Besides simple examples, rhetorical tools such as similes and metaphors are very helpful in communicating with lay audiences. In his report to the National Science Board, G.R. Funkhouser points out, "Spokesmen of science may tend

to address themselves to a 'public' that they conceive as being much like themselves" (84). Because of their expertise in a subject, these spokesmen tend to think and speak abstractly. But the audiences they often try to reach live in a world of sensory images. An entity comes to exist only if it appeals to their senses. Abstract theories and principles are beyond the realm of their everyday lives and therefore make no meaning as far as they are concerned. In order to communicate abstract matter to them, writers have to appeal to their imagination by using rhetorical tools, which add a perceptible quality to abstract concepts and bring them within the comprehensive level of the audiences. Huxley's scientific prose provides an illustrative lesson for the writers who have to deal with abstract theories.

Human element or human interest is another technique that Huxley uses in his popular essays. General readers, who are not inclined to read heavy subject matter, often will lose interest in something that does not have significance to human beings. To make the subject informative as well as interesting to them, writers have to relate the subject through human characters. The presence of human beings, their struggles, sufferings, and triumphs sustain readers' attention to the subject. When writers present the subject matter as something that has affected or is capable of affecting people, they may be motivated to read the subject to learn from their fellow human beings' struggles and successes. Huxley's essays are peopled with

scientists, fictive and historical characters, readers themselves, and his own self.

Another important technique in communicating with lay people is the use of appropriate language. Many writers fail in this aspect because of their inability to translate their message into lay terms, which is hard work for scientists or anyone who is practicing a discipline that has its own language. Nevertheless, unless writers make serious efforts to overcome the problem, meaningful communication cannot take place. Huxley's prose is a fine example of the simple and lucid language that writers need to adapt to communicate with lay audiences. Simple and concrete words contribute significantly to Huxley's success.

In addition to all the specific techniques, there are certain general characteristics of Huxley that writers may emulate to become successful in their careers. The most important one is seriousness. Writers have to be serious about their pursuit and need to have a purpose before trying to disseminate scientific information. Huxley was committed to the cause of popularizing. In the preface to the Collected Essays, vol. 8, he says, "I have not been one of those fortunate persons who are able to regard a popular lecture as a mere hors de'oeuvre, unworthy of being ranked among the serious efforts of a philosopher" (v). He was concerned with the scientific education of common people, whose ignorance of even the simplest things of their lives troubled him throughout his life. He believed that human

lives depend upon the world of nature around them. To live harmoniously with nature, they need to understand the phenomena of the world and the rules of nature that control them. He was convinced that science could alleviate the sufferings of mankind. From the beginning of his popularization, he was repeatedly telling the public that science is organized common sense and not a mystical power.

The second major general characteristic is hard work or preparation. Reaching the ignorant, reluctant, indifferent, and even hostile masses is often hard. Writers may find it difficult to make the public understand what they try to convey to them. There is a large gap between their technical language and the public's common language. Even if the writers are able to bridge or at least narrow the gap, they may not be fully clear to the public because clear communication does not come easy. Only hard work on the part of the writers ensures success in the field of popularization.

Huxley worked hard to achieve his clarity of expression. Once he wrote to his French translator, "I have a great love and respect for my native tongue, and take great pains to use it properly. Sometimes I write essays half-a-dozen times before I can get them into the proper shape, and I believe I became more fastidious as I grow older" (L. Huxley 1: 308).

Like writing, preparing for public addresses, too, took lot of his time. Henry Fairfield Osborn recalls Huxley's

comment on this subject:

Huxley's public addresses always gave me the impression of being largely impromptu; but he once told me: "I always think out carefully every word I am going to say. There is no greater danger than the so-called inspiration of the moment, which leads you to say something which is not exactly true, or which you would regret afterwards." (L. Huxley 2: 440)

Writing or speaking to lay people requires hard work or preparation, an essential quality to reach them successfully.

Finally, if writers can be versatile and relate relevant issues from outside the sphere of the immediate subject, the public will receive the subject well. Huxley lived a life as fully outside the laboratory as in it. Even in his student days at Charing Cross School of Medicine, he spent, as Cyril Bibby points out, "a good deal of his energy in reading outside the prescribed fields of study" (Scientist 7). He once jocularly remarked that he wished he had as many lives as a cat so that he could explore all corners of the universe (L. Huxley 2: 433). The voracious reading habit made him knowledgeable about many fields of life, and he depended on his vast source of knowledge to make his essays impressive. Also, references to the bitter controversy between the Church and Science added more interest to his presentation. Discussing relevant social

ramifications of the immediate subject matter without antagonizing audiences certainly helps writers to keep their audiences interested in the subject matter.

Regarding popularization, W.E. Flood commented,

It is strange that, in spite of the importance of popular science, little study seems to have been made of the techniques of presenting it. . . .

Many ordinary people feel that science is beyond them, that the gap cannot be bridged, but this not be so. The solution may well be found in a more intensive and more extensive study of the techniques of exposition. (3)

Flood is right in his assertion that an analysis of the techniques of exposition will help clear the false notion that science is beyond common people's understanding.

Thomas Henry Huxley's popular essays point out to lay people that science is not outside their comprehensive level, and they point out to scientific writers that several techniques are available to them to take science to the masses.

WORKS CITED

Primary Sources:

- Huxley, Thomas Henry. Collected Essays: Methods and Results. New York: Greenwood press, 1968. Vol. 1.
- . Collected Essays: Darwiniana. Vol. 2.
- . Collected Essays: Science and Education. Vol. 3.
- . Collected Essays: Discourses Biological and Geological. Vol. 8.
- . American Addresses. New York: D. Appleton and Company, 1890.
- . Physiography. New York: D. Appleton and Company, 1892.
- . Science Primers: Introductory. Toronto: Canada Publishing Co., 1881.

Secondary Sources:

- Abelson, Philip H. "Communicating with the Publics." Science 5 Nov. 1976: 565.
- Altick, Richard D. Victorian People and Ideas. New York: Norton and Company, 1973.
- Aristotle. Rhetoric. Trans. Richard Mc keon. New York: Random House, 1941.
- Ashforth, Albert. Thomas Henry Huxley. New York: Twayne Publishers, 1969.
- Avery, Gillian. Victorian People. New York: Holt,

- Rinehart and Winston, 1970.
- Basalla, George, William Coleman, and Robert Kagon, eds.
Victorian Science. New York: Doubleday & Company, Inc.,
1970.
- Baskin, Otis, and Sam J. Bruno. "A Transactional System
Model of Communication: Implications for Transactional
Analysis." Journal of Business Communication 15 (Fall,
1977): 65-73.
- Bell, Peter, and David Coombe, trans. Strasburger's
Textbook of Botany. New English Edition. New York:
Longman, 1976.
- Berne, Eric. Transactional Analysis in Psychotherapy.
New York: Grove Press, 1961.
- Best, Geoffrey. Mid-Victorian Britain. New York:
Schocken Books, 1972.
- Bibby, Cyril. T.H. Huxley: Scientist, Humanist and
Educator. London: Watts, 1960.
- . "The South London Working Men's College: A Forgotten
Venture." Adult Education 28 (1955): 211-21.
- Bitzer, Lloyd. "The Rhetorical Situation." Philosophy and
Rhetoric 1 (1968): 1-15.
- Blinderman, Charles S. "T.H. Huxley's Theory of Aesthetics:
Unity in Diversity." Journal of Aesthetics and Art
Criticism 21 (1962): 49-55.
- . "Semantic Aspects of T.H. Huxley's Literary Style."
Journal of Communication 12 (1962): 171-78.
- Boettinger, H.M. Moving Mountains. London: The Macmillan

- Company, 1969.
- Buckler, William E. ed. Prose of the Victorian Period.
Boston: Houghton Mifflin, 1958.
- Campbell, George. The Philosophy of Rhetoric: The Rhetoric
of Blair, Campbell and Whately. Ed. James L. Golden and
Edward P.J. Corbett. New York: Holt, Rinehart and
Winston, 1968.
- Carr-Smith, Norma. "Overcoming Defensive Barriers to
Communication: A Transactional Analysis Approach." The
ABCA Bulletin 41 (1978): 12-15.
- Carson, David L. "Audience in Technical Writing: The Need
for Greater Realism in Identifying the Fictive Reader."
Teaching Technical Writing: Teaching Audience Analysis
and Adaptation. Ed. Paul V. Anderson. Association for
Teachers of Technical Writing, 1980. 24-30.
- Chesterton, George K. The Victorian Age in Literature.
New York: Henry Holt and Company, 1913.
- Cicero. De Oratore. Trans. J.S. Watson. New York: Harper
& Brothers, 1895.
- Clarke, M.L. Rhetoric at Rome: A Historical Survey. New
York: Barnes & Noble, Inc., 1963.
- Clevenger, Theodore Jr. Audience Analysis. New York: The
Bobbs-Merrill Company, 1966.
- Corbett, Edward P.J. Classical Rhetoric for the Modern
Student. 2nd ed. New York: Oxford University Press,
1971.
- Darwin, Frances, ed. The Life and Letters of Charles

- Darwin. 2 vols. New York: Basic Books, Inc., 1959.
Vol.2.
- Darwin, Frances, and A.C. Seward, eds. More Letters of Charles Darwin. 2 vols. New York: D. Appleton and Company, 1903. Vol. 1.
- Davis, Ainsworth J.R. Thomas H. Huxley. New York: E.P. Dutton & Co., 1907.
- Dittmer, Howard Jones. Modern Plant Biology. New York: Van Nostrand Reinhold Co., 1972.
- Ede, Lisa. "On Audience and Composition." CCC 30 (1979): 291-95.
- Eisely, Loren. Introduction. On a Piece of Chalk. By T.H. Huxley. New York: Charles Scribner's Sons, 1967.
- Faraday, Michael. The Chemical History of a Candle. New York: Thomas Y. Crowell Company, 1957.
- Flood, W.E. The Problem in Vocabulary in the Popularization of Science. London: Oliver and Boyd, 1957.
- Foster, Michael, and E. Ray Lankester, eds. The Scientific Memoirs of Thomas Henry Huxley. 5 vols. Macmillan & Co., 1898-1903. Vol. 1.
- Funkhouser, G.R. Science at the Bicentennial--A Report from the Research Community. Washington, D.C., Govt. Printing Office, 1976.
- Gastel, Barbara. Presenting Science to the Public. Philadelphia: ISI Press, 1983.
- Gardner, Joseph H. "A Huxley Essay as 'Poem.'" Victorian Studies 14 (1970): 177-91.

- Golden, James, and Edward P.J. Corbett. Introduction. The Rhetoric of Blair, Campbell and Whately. New York: Holt, Rinehart and Winston, 1968.
- Halloran, Michael S., and Annette N. Bradford. "Figures of Speech in the Rhetoric of Science and Technology." Essays on Classical Rhetoric and Modern Discourse. Eds. Robert J. Connors, Lisa S. Ede, and Andrea A. Lunsford. Carbondale and Edwardsvill: Southern Illinois University Press, 1984. 179-92.
- Houghton, Walter. "The Rhetoric of T.H. Huxley." UTO 18 (1949): 159-75.
- Houp, Kenneth W., and Thomas Pearsall E. "Analyzing Your Audience." Reporting Technical Information. 5th ed. Los Angeles: Glencoe Press, 1984. 20-47.
- Huxley, Aldous. "T.H. Huxley as a Man of Letters." The Olive Tree. New York: Harper's, 1937.
- Huxley, Leonard. Life and Letters of Thomas H. Huxley. 2 vols. New York: Appleton and Company, 1901.
- Irvine, William. Apes, Angels, and Victorians. New York: Mc Graw Hill Book Company, 1955.
- Jenson, Vernon J. "The Rhetorical Strategies of Thomas H. Huxley and Robert G. Ingersall: Agnostics and Roadblock Removers." Speech Monographs 32 (1965): 59-68.
- Kowalewsky, A. "Abstract of a Speech on Huxley Delivered at the Zoological Congress of 1895." Nature 53 (1895): 651.
- Kroll, Barry. "Writing for Readers: Three Perspectives on

- Audience," CCC 35 (May, 1984): 172-75.
- Lankester, Ray E. "Huxley's Collected Essays." Nature 49 (1894): 310-11.
- Long, Russell. "Writer-Audience Relationships." CCC 31 (May, 1980): 221-26.
- Mitchell, Chalmers. Thomas Henry Huxley: A Sketch of His Life and Work. New York: G.P. Putnam's Sons, 1900.
- Mitchell, Wendell. The Pigeon. Sumter, S.C.: Levi Publishing Co., 1963.
- Ong, Walter J. "The Writer's Audience is Always a Fiction." PMLA 90 (1975): 9-21.
- Paradis, James. T.H. Huxley: Man's Place in Nature. Lincoln: University of Nebraska Press, 1978.
- Park, Douglas B. "Analyzing Audiences." CCC Dec. 86: 478-88.
- Pawling, Randolph J. Dr. Samuel Guthrie: Discourse of Chloroform. New York: Brewster Press, 1947.
- Pearsall, Thomas E. Audience Analysis for Technical Writing. Beverly Hill: Glencoe Press, 1969.
- Peterson, Houston. Thomas H. Huxley: Prophet of Science. New York: Longmans, Green and Co., 1932.
- Reddick De Witt C. Literary Style in Science Writing. Magazine Publishers Association, 1969.
- Smalley, G.W. Anglo-American Memories. Second Series. London: Duckworth, 1912.
- Sawyer, Thomas M. Introduction. Technical and Professional Communication. Ed. Thomas Sawyer. Ann Arbor:

Professional Communication Press, 1977. 1-8.

Thatcher, Virginia S. History of Anesthesia.

Philadelphia: J.B. Lippincott Company, 1953.

Walzer, Arthur. "Articles from the 'California Divorce

Project': A Case Study of the Concept of Audience." CCC

36 (1985): 155-58.

White, Myron L. "The Informational Requirements of

Audiences." Teaching Technical Writing: Teaching

Audience Analysis and Adaptation. Ed. Paul V. Anderson.

Association for Teachers of Technical Writing, 1980. 6-

17.

2
VITA

Mahalingam Subbiah

Candidate for the Degree of
Doctor of Philosophy

Thesis: POPULARIZING SCIENCE: THOMAS HENRY HUXLEY'S STYLE

Major Field: English

Biographical:

Personal Data: Born in Tamilnadu, India, December 10, 1947, the son of P.S.A. and Karpagavalli Subbiah. Married to Sheela Ramachandran on August 19, 1983.

Education: Graduated from Government High School, Koradacheri, Tamilnadu, India, in May, 1966; received Bachelor of Science Degree in Botany in May 1970 and Bachelor of Education Degree in May 1971 from Annamalai University, India; received Master of Arts Degree in English from Madras University in May 1978; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in December, 1987.

Professional Experience: Graduate Teacher, Vana Vani High School, Madras, India, September, 1971 to July, 1979; Post Graduate Teacher, S.R.M. Higher Secondary School, Madras, India, July, 1979 to August, 1981; Teaching Assistant, Department of English, Oklahoma State University, August, 1981 to December, 1986.