75-21,792

CROUCH, Laura Ernestine, 1946-
THE SCIENTIST IN ENGLISH LITERATURE: DOMINGO GONSALES (1638) TO VICTOR FRANKENSTEIN (1817).

The University of Oklahoma, Ph.D., 1975
Literature, general

Xerox University Microfilms, Ann Arbor, Michigan 48106

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE SCIENTIST IN ENGLISH LITERATURE:

DOMINGO GONSALES (1638) TO VICTOR FRANKENSTEIN (1817)

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

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Norman, Oklahoma

1975

THE SCIENTIST IN ENGLISH LITERATURE:

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APPROVED BY

DISSERTATION COMMITTEE

ACKNOWLEDGMENTS

I first became interested in the relationships between science and literature as an undergraduate student at the University of Oklahoma. I owe a great deal of thanks to numerous professors of English and of the History of Science at the University of Oklahoma and at the University of Texas who encouraged me to pursue these studies.

I am particularly indebted to Dr. Joanna E. Rapf, Dr. Paul G. Ruggiers, and Dr. James H. Sims, Professors of English, and Dr. Duane H. D. Roller, Professor of History of Science, for reading this paper. Their comments and suggestions have been most helpful. I would also like to thank the faculty, staff, and students connected with the University of Oklahoma History of Science Collections. Their assistance in locating materials, their interest in the project, and their friendship I have greatly appreciated.

Finally, I would like to thank Professor David P. French for directing this study. I am very grateful for the helpful advice and invaluable criticisms he has provided over the past two years. Because of the time and encouragement he so willingly gave me, the "dream" which led me to begin this project did not become a "nightmare."

. . . Life consists
Of propositions about life. The human

Revery is a solitude in which
We compose these propositions, torn by dreams,

By the terrible incantations of defeats
And by the fear that defeats and dreams are one.

The whole race is a poet that writes down
The eccentric propositions of its fate.

--Wallace Stevens

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INTRODUCTION

In 1817 Mary Shelley completed *Frankenstein*, the story of a scientist who, with every intention of using his knowledge to help mankind, created a monster who destroyed many of the people Frankenstein loved and who eventually caused his creator's death also. *Frankenstein* is a landmark in the development of the science fiction genre, for Dr. Frankenstein is the first scientist to appear in literature who has the power to create a force which subsequently destroys part of society. Frankenstein was not the first fictional scientist whose work was destructive, for Jonathan Swift, in the "Voyage to Laputa" in *Gulliver's Travels*, had presented a picture of a land laid waste as a result of the scientists' senseless schemes. Frankenstein was, however, the first scientist in literature who created a destructive agent through a successful scientific process.

Before 1817, I suggest, *Frankenstein* could not have been written. There are many reasons why such a novel did not appear a hundred years earlier, in 1700 for example. Brian W. Aldiss, a contemporary critic of science fiction, discusses two changes which occurred in the eighteenth century which made possible the creation of a *Frankenstein*.

In the opening chapter of Billion Year Spree: The True History of Science Fiction, Aldiss associates Frankenstein and much of the science fiction written since with the Gothic tradition and discusses the aesthetic changes which made the Gothic novel a popular literary form in the latter part of the eighteenth century.[1] He also discusses some of the important scientific work which occurred after 1700. The increased interest in scientific exploration, particularly in the South Seas, he says, led to increased debate concerning the fixity versus the mutability of species. The foreshadowers of Charles Darwin, particularly his grandfather, Erasmus, suggested that natural forces could cause animal species to change.[2] Aldiss implies, then, that not until the end of the eighteenth century was there a scientific atmosphere in which a Frankenstein monster could be seriously imagined. When men began to accept the idea that there was no Great Chain of Being, the thought that a scientist could create a new species became credible enough to be frightening.

Aldiss's discussion of Frankenstein demonstrates the two methods most critics of science fiction have used to analyze early representatives of the genre. Often they have either considered these works as part of broader literary movements or they have viewed them only as vehicles for comment on new scientific theories.[3] The first approach is, I believe, too broad, the second too narrow. I would like to suggest a third approach. A distinguishing feature of many seventeenth- and eighteenth-century works generally included in critical discussions of science fiction is that they contain well-drawn scientists. While reading Aldiss, I realized that there is a third reason why a Frankenstein would not have been envisioned in 1700--Dr. Frankenstein, the powerful scientist, did not exist as a stereotype in the public mind. It was not scientific theory alone that gained credibility during the hundred years preceding the publication of Frankenstein. During this time, people came to believe for the first time that the scientist controlled powers that could change the world. I began then to search for representative scientist characters who reflected public opinion concerning scientific activity. I found, in Restoration and eighteenth-century literature, several definite types of scientists, differentiated by the amount and type of power they possessed. Using these figures as models, I would like to show the evolution of the scientist character which led to Frankenstein--the scientist with the power to create destruction.

The Aristotelian scientist, who dominated scientific thought in Britain until the seventeenth century, was a man who provided a certain, logical picture of the universe, but he did not discover new facts about nature or use his knowledge to improve the world. Francis Bacon, in the early seventeenth century, envisioned a new role for the scientist.

He felt that men could discover new natural phenomena and that these discoveries could give men a power to use nature to benefit mankind. Throughout the seventeenth and eighteenth centuries, those scientists who chose to believe Bacon and follow the experimental method continually reasserted that science could be used to create power for men. It was many years, however, before non-scientists were willing to accept this claim.

Slowly during the late seventeenth and eighteenth centuries, scientific discoveries were made which did increase men's knowledge and power. Isaac Newton's theories concerning gravity provided the proof many needed that modern men could discover new knowledge and produce beautiful theories unknown to the ancients. In the early eighteenth century Hans Sloane, who was then Physician in Ordinary to George II, successfully inoculated the royal family against small pox, thus demonstrating the power of science to produce means of controlling serious diseases.[4] In 1750 Stephen Hales developed a ventilator for Newgate prison which reduced the number of prison deaths from seven or eight per week to one or two per month.[5] In 1758 John Harrison invented a chronometer accurate enough that it could be used to measure longitude, and men accomplished an advance in navigation that many had said was impossible.[6] Again, in 1783, when J. F. Pilâtre de Rozier ascended in a hot air balloon, man accomplished something thought to be impossible.[7] Many new and improved sources of energy were also developed during the eighteenth century. John Smeaton designed wind and water wheels that greatly increased the amount of power that could be derived from those elements.[8] James Watt invented an industrial steam engine that was much more efficient than those developed before it,[9] and, although they were not then used to provide an effective source of power, many phenomena of electricity were discovered and numerous electrical experiments were performed during the century.[10]

During the years when scientists were claiming to be able to advance knowledge and create power and were then setting out to prove the validity of such claims, numerous scientists appeared in literature. Sometimes these men were, like Swift's Laputans, ludicrous, unattractive characters who wasted their time on vain pursuits. Sometimes they were, like Robert Paltock's Peter Wilkins, men who used their scientific knowledge to help complete a divine plan for the advancement of civilization. Different ones of these fictional scientists were given certain powers by those who envisioned them, but none before Frankenstein had the power to create a force which, independent of the divine will, could be used by men for good or evil. Yet these early scientists seem to go through a distinct series of changes in the public mind as men became more aware of the real scientists' power.

The earliest figure of the experimental scientist to appear in literature was the "virtuoso" who was used in the Restoration to satirically represent philosophers who thought they had power but, in reality, did not. The virtuoso's experiments produced neither new knowledge nor benefits for mankind. A second satirical scientist character, the "projector," appeared early in the eighteenth century. He had gained no scientific power, but he had enough political power to be destructive, for he wrecked the country around him by attempting projects that did not work. Through this scientist, writers suggested that the experimenter should be responsible to society for his failures.

As the century progressed writers became more willing to consider seriously the claims of the scientist, and there appeared in literature various non-satirical depictions of the scientist, used to examine his potential moral power. At his best, this scientist was presented as an instrument used by God to complete His will for the world. At his worst, he was shown to be a moral failure, one who gained a pitifully little knowledge only at the expense of his other human responsibilities. With few exceptions, these scientists also were responsible only for their failures. The scientist who fulfilled his promises and obtained his goals was a hero--he had both moral and scientific power. Those who failed morally usually failed scientifically as well. As men became more and more convinced of and enamoured by the doctrine of progress, however, this picture changed. They began to argue that anyone who pursued knowledge, whether he reached his goal or not, was advancing science and thus helping mankind. People began to view science as a force which, almost of necessity, would make life better. Some began to dream of utopias founded on the rock of scientific knowledge.

Mary Shelley lived in an environment of scientific optimism, and she questioned the validity of the enthusiasm of those around her. Other writers had questioned the scientist's ability to gain power; she questioned his ability to use constructively the tremendous powers he might be able to gain. She created a scientist who was able to do what he proposed--to create life out of death--and she made him responsible not for his failures, but for his success.

By looking at the scientists that appear in literature between 1638 when the first fictional experimental scientist was depicted in Bishop Godwin's <u>The Man in the Moone</u> and 1817 when <u>Frankenstein</u> was published, one can see the gradual public acceptance of the figure of the experimental scientist. Only after the people of England came to seriously believe the scientist's claim that he would discover new knowledge and give men new powers did they begin seriously considering the moral obligations of the successful scientist. Only then could Mary Shelley portray in <u>Frankenstein</u> the frightening picture of the havoc scientific power could wreak in an imperfect world.

CHAPTER I

THE BACONIAN SCIENTIST: THE DREAM OF POWER

There are so many current definitions of science fiction that it is often difficult to determine whether any individual work should or should not be included in the genre.[1] A much easier task is to search for particular scientific characters, devices, or themes that appear in literary works. Whether one wishes to include Lucian's True History or Kepler's Somnium in the corpus of science fiction or not, they can be discussed in conjunction with other moon voyages which have appeared in literature.[2] Likewise, without developing a definition for science fiction and limiting oneself to certain science fiction works, one can discuss those works in which scientist characters appear and can obtain from them certain impressions of the public response to science and the historical scientist.

Not until the early seventeenth century, when Francis Bacon had published his ideas concerning empirical science and the place in society of the experimental scientist, did scientists begin to appear as characters in fictional works. The first fictional depiction of a scientist that I have found in British literature was included in The Man in the

Moone by Francis Godwin, published in 1638. The scientist, Domingo Gonsales, was an experimenter who relied on empirical evidence rather than logical deductions in his search for knowledge. He was one of many experimental scientists who preceded Dr. Frankenstein.

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In order to understand the character of Domingo Gonsales, however, one must first note the major differences between the Aristotelian philosophy which dominated science in sixteenth-century England and the new experimental philosophy to which Domingo Gonsales is devoted.

As Richard Foster Jones has demonstrated in Ancients and Moderns: A Study of the Rise of the Scientific Movement in Seventeenth-Century England, science in the sixteenth century was dominated by those who followed the ancients. A student at Oxford in the sixteenth century, for example, who failed to agree with Aristotle was fined five shillings for each point at which he departed from Aristotelian logic.[3] Belief in the knowledge of the ancients was so firm that Sir Thomas Elyot felt qualified to write a medical treatise, though he was not a physician, on the strength of his knowledge of Galen, Celsus, Pliny, and Dioscorides.[4] In other words, the source of knowledge for Elyot was authority, not experience or personal observation and experimentation.

Elyot also reflects his respect for the ancients in

The Boke Named The Governour, particularly in those passages which describe how a young gentleman should be educated. One sees that for Elyot the study of science was relatively unimportant. At the age of fourteen, in the midst of his studies of the ancient orators and historians, a young man was to be taught the tables of Ptolemy and cosmography.[5] The purpose of these studies, Elyot says, is to provide pleasure for the student. Later philosophers would agree that scientific study yields pleasure, but they would say that it can also yield new power, an idea Elyot and most men of his century did not conceive. Describing the student's study of cosmology, then, Elyot pictures the benefits he feels one can receive from this occupation.

> For what pleasure is it, in one houre, to beholde those realmes, cities, sees, ryuers, and mountaynes, that uneth in an olde mannes life can nat be iournaide and pursued: what incredible delite is taken in beholding the diuersities of people, beastis, foules, fisshes, trees, frutes, and herbes: to knowe the sondry maners and conditions of people. and the varietie of their natures, and that in a warme studie or perler, without perill of the see, or daunger of longe and paynfull iournayes: I can nat tell what more pleasure shulde happen to a gentil witte, than to beholde in his owne house euery thynge that with in all the worlde is contained.[6]

In the early seventeenth century, there were a few men who were not satisfied simply to accept the knowledge of the ancients. Among these was Sir Francis Bacon, who called for a new science--one that could uncover in nature previously hidden truths. He felt that a new science would require new scientists, willing to engage in activities not traditionally associated with science. In the first book of the Novum Organum, published in 1620, Bacon compares two scientist figures who he says might both work for the good of society. The traditional Aristotelian scientist he sees as a man who distributes information and inspires logical thought. The new scientist he expects to be a man who discovers new knowledge through experimentation.

> . . . we are no way bent upon disturbing the present Philosophy, or any other that is, or shall appear, more perfect: the common System, and others of the same Kind, may continue, for us, to cherish Disputes, embellish Speeches, etc. the Philosophy we would introduce, will be of little Service in such Cases . . . Let there be, therefore, by joint Consent, two Fountains, or Dispensations, of Doctrine; and two Tribes of Philosophers, by no means Enemies or Strangers, but Confederates and mutual Auxiliaries to each other: and let there be one Method of cultivating, and another of discovering the Sciences. And to those who find the former more agreeable, for the sake of Dispatch, or upon civil Accounts, or because the other Course is less suited to their Capacities . . . we wish Success in their Procedure; and they may obtain their Ends. But if any one has it at heart, not only to receive the Things hitherto discover'd,but to advance still farther; and not to conquer an Adversary by Disputation, but to conquer Nature by Works; not neatly to raise probable Conjectures, but to know Things of a certainty, and demonstratively; let him, as a true Son of the Sciences, join Issue with us, if he pleases: that, leaving the Entrance of Nature, which infinite Numbers have trod, we may, at length, pass into her inner Courts.[7]

The Aristotelian scientist attempted to logically demonstrate that certain ideas were true. Aristotle felt that one could find truth by reasoning through scientific syllogisms and that, if the reasoning was correct, such truth was undeniable. "Since the object of pure scientific knowledge cannot be other than it is," he says in the

Posterior Analytics, "the truth obtained by demonstrative knowledge will be necessary."[8] By "demonstrative knowledge" he means ideas proved true through syllogistic reasoning.

In order to reason in this way, the philosopher needed certain premises he could accept without logical demonstration. Aristotle felt that some knowledge was available to men through the senses that was certain though not demonstrable. Through the senses, the Aristotelian received the information he needed to begin the process of logical reasoning that would lead to truth.

> It is also clear that the loss of any one of the senses entails the loss of a corresponding portion of knowledge, and that, since we learn either by induction or by demonstration, this knowledge cannot be acquired. Thus demonstration develops from universals, induction from particulars; but since it is possible to familiarize the pupil with even the so-called mathematical abstractions only through induction . . . it is consequently impossible to come to grasp universals except through induction. But induction is impossible for those who have not sense-perception. For it is sense-perception alone which is adequate for grasping the particulars: they cannot be objects of scientific knowledge, because neither can universals give us knowledge of them without induction, nor can we get it through induction without sense-perception.[9]

Aristotle felt, then, that man could receive truth in two ways. Through his senses, he could receive certain primary premises, and then, through a process of syllogistic reasoning, he could establish universal truths from these premises. As Aristotle says in Book II of the Posterior Analytics,

> Thus it is clear that we must get to know the primary premisses by induction; for the method by which

> even sense-perception implants the universal is inductive. Now of the thinking states by which we grasp truth, some are unfailingly true, others admit of error--opinion, for instance, and calculation, whereas scientific knowing and intuition are always true: further, no other kind of thought except intuition is more accurate than scientific knowledge, whereas primary premisses are more knowable than demonstrations, and all scientific knowledge is discursive.[10]

The most attractive feature of the Aristotelian method was the completeness and certainty of the knowledge men felt they received through the process of logical reasoning. Peter Heylyn, an Aristotelian who published a cosmography in 1670, indicates in his remarks "To the Reader" that he feels his book should contain all the knowledge possible on the subject.

> Perfection and exactness is to be expected in each kind of Science, as is observed by Aristotle in the second Book of his Ethicks . . . as far forth as the condition of the Argument may be capable of it. And so much, if I have attained unto, it is all which can with reason be expected from me. To look for more, were as improper and absurd (in the words of Aristotle) as for an Artist to expect Tropes of Rhetorick from a Mathematician, or Demonstrations from an Orator.[11]

Sir Francis Bacon, however, did not believe that truth was to be discovered through Aristotelian syllogisms. Aristotle, Bacon felt, had "made his Natural Philosophy such an absolute Slave to his Logic, as render'd it contentious, and, in a manner, useless."[12] Bacon criticized the logical method primarily because he felt the foundation in experience behind the conclusions drawn was not sufficient for discovering truth.

> There are two Ways of searching after, and discovering Truth: the one, from Sense and Particulars,

> rises directly to the most general Axioms; and resting upon these Principles, and their unshaken Truth, finds out intermediate Axioms: and this is the Method in use. But the other raises Axioms from Sense and Particulars, by a continued gradual Ascent; till at last it arrives at the most general Axioms: which is the true Way; but hitherto untried.[13]

When one establishes truth through syllogisms, Bacon says, the idea has come more from the mind than from experience with the phenomenon being explained. The Aristotelian method, then, exalts man's concept of himself, but it does not help him find truth.

> The Root of all the Mischief in the Sciences, is this; that falsly magnifying and admiring the Powers of the Mind, we seek not its real Helps.[14]

The man who depends on the Aristotelian method trusts his understanding and his senses to discover truth. For Bacon, though, neither of these tools is reliable. First, the understanding is not capable of reaching truth by itself.

> The Understanding being left to itself, in a sober, patient, and sedate Genius, and especially if unprejudiced by any former Doctrine; will make some Attempt in the second or right Way, but to little Advantage: for unless regulated and assisted, the Understanding is here very unequal, and absolutely unfit to conquer the Obscurity of Things.[15]

The understanding fails to uncover truths for several reasons. The understanding is pleased with order, Bacon says, and will impose its own concept of order on phenomena even when no order exists there.

> The Mind has this Property, that it readily supposes a greater Order and Conformity in Things, than it finds: and tho' many Things in Nature are singular, and extremely dissimilar; yet the Mind is still imagining Parallels, Correspondencies, and Relations between them; which have

> no Existence. Hence the Fiction, that all the celestiall Bodies moved in perfect Circles; hence the fictitious Element of Fire, with its Orb, was added to the three sensible Elements, to make them four; and such kind of Dreams.[16]

The understanding also discovers pleasing similarities where none exist. The mind becomes infatuated with a few beautiful ideas and tries to extend those ideas throughout nature.

> The human Intellect is most moved by those Things that strike and enter it all at once; so as to fill and swell the Imagination: but for the rest, it feigns and supposes them, after a certain imperceptible manner, to be like those few that possess the Mind: whilst the Understanding is quite slow, and unfit to pass so readily to remote and dissimilar Instances, whereby Axioms are tried, as it were, in the Fire . . .[17]

Another problem with the understanding, Bacon says, is that the mind cannot free itself from emotion. Scientific truths derived from the understanding will be colored by hopes, fears, and superstitions.

> The Light of the Understanding is not a dry or pure Light, but drench'd in the Will and Affections; and the Intellect forms the Sciences accordingly: for what Men desire should be true, they are most inclined to believe. The Understanding, therefore, rejects Things difficult, as being impatient of Enquiry; Things just and solid, because they limit Hope; and the deeper Mysteries of Nature, thro' Superstition: it rejects the Light of Experience, thro' Pride and Haughtiness; as disdaining the Mind should be meanly and waverily employ'd: it excludes Paradoxes, for fear of the Vulgar. And thus the Affections tinge and infect the Understanding, numberless Ways; and sometimes imperceptibly.[18]

So, Bacon says, man cannot trust the mind to find truth. Syllogisms created in the mind, then, are simply words which stand for things that we do not yet understand.

> Syllogism consists of Propositions, Propositions of Words, and Words are the Signs of Notions; therefore, if our Notions, the Basis of all, are confused, and over hastily taken from Things; nothing that is built upon them can be firm . . .[19]

Just as Bacon did not trust man's understanding, so he did not trust the senses to discover the premises for truth. "The Subtilty of Nature," he says, "far exceeds the Subtilty of the Sense and Understanding . . ."[20] One who trusts his senses is aware only of those things which are visible. So, the many things in the world that cannot be seen remain uninvestigated.

> But much the greatest Impediment and Deviation of the Understanding, proceeds from the Dullness, Incompetency, and Fallacies of the Senses; whence the Things that strike the Sense, unjustly over-balance those that do not strike it immediately: So that Contemplation usually ends with Sight; and little or no Observation is made of Things invisible. And hence all the Operations of the Spirits, included in tangible Bodies, all subtile Organizations, and the Motions of the Parts, are unknown to Mankind: and yet, unless these are discover'd and brought to Light, nothing very considerable can be done in Nature, with regard to Works. Nay, the Properties of the common Air, and numerous Bodies of greater Subtlety than that, remain almost unknown: For sense, of itself, is a weak and erroneous Thing.[21]

The alternative to Aristotle's method, Bacon says, is to seek the hidden truths of nature through orderly experimentation which can overcome the faults of both the understanding and the senses. To illustrate this point, he compares Aristotle's natural history to the natural history which, according to Bacon, should be written.

> For as to Matter of Experience, there is nothing hitherto well discovered, verified, adjusted, weighed, or measured, in Natural History: but whatever is undefin'd

> and vague in Observation, must needs be fallacious and deceitful in the Information. And if this shall seem surprizing, or the Complaint appear unjust, to any one; whilst so great a Philosopher as Aristotle, assisted with the Purse of so great a Prince as Alexander, has compiled such an exact History of Animals; and whilst some others, with greater Diligence, tho' with less Bustle, have contributed many Things thereto . . . he does not seem sufficiently to understand our Meaning. A Natural History, compiled for its own sake, is one thing; and a Natural History, collected for informing the Understanding, in order to the building up of Natural Philosophy, is another. And these two Histories, as they differ in other respects; so principally in this, that the former contains various Descriptions of natural Bodies, but not Experiments of mechanic Arts. For as, in civil Life, the Temper of a Man, and the secret Dispositions of his Mind and Affections, are better understood, when he is ruffled, than otherwise; so the Secrets of Nature are better got out by the Torturing of Arts, than when suffer'd to take their own course. And, therefore, we may then have good Hopes of Natural Philosophy, when Natural History, which is the Basis thereof, shall be better supplied; and not before.[22]

Bacon stresses that experimentation alone is not sufficient to uncover truth. The experiments must be conducted in an orderly fashion so that proper conclusions may be drawn from them.

> And not only a larger Stock of Experiments is to be sought, and procured, of a different Kind from what has hitherto appeared; but also a quite different Method, Order, and Procedure, is to be introduced, for continuing and advancing Experience itself: for vague Experience, that pursues nothing but itself, is, as was before observed, a mere groping about in the dark; and rather amazes Mankind, than informs them. But when Experience shall be conducted by certain Laws, orderly and consequentially, we may have better Hopes of the Sciences.[23]

Experiments, Bacon says, should lead to the formulation of axioms that should then be tested by other experiments, "For the Way lies not thro' a Plain; but thro' Mountains and Valleys: first ascending to Axioms, and then descending to Works."[24]

Finally, Bacon compares the two scientific processes--the Aristotelian method of logical deduction and his own method of experimentation--by using the now famous analogy of the spider and the bee.

> Those who have treated the Sciences, were either Empirics, or Rationalists. The Empirics, like Ants, only lay up Stores, and use them; the Rationalists, like Spiders, spin Webs out of themselves: but the Bee takes a middle Course, gathering her Matter from the Flowers of the Field and Garden; and digesting and preparing it by her native Powers. In like manner, that is the true Office and Work of Philosophy, which, not trusting too much to the Faculties of the Mind, does not lay up the Matter, afforded by Natural History and Mechanical Experience, entire or unfashion'd in the Memory; but treasures it, after being first elaborated and digested in the Understanding: and, therefore, we have a good Ground of Hope, from the close and strict Union of the experimental and rational Faculty; which have not hitherto been united.[25]

One reason why the Aristotelian method was attractive to sixteenth- and seventeenth-century men, then, was that they believed they could obtain complete and certain truth by following Aristotle's method. Bacon tries to prove, however, that the senses and the understanding are imperfect and cannot determine truth. To find real truth, he says, men must delve into nature with experiments and then formulate theories that can be verified with further experiments.

Another reason why the Aristotelian system appealed to men was that it was traditional. Richard Foster Jones, again in Ancients and Moderns, traces the idea that the natural world was gradually decaying from Francis Shakelton's treatise on A Blazing Star, published in 1580, through Joseph Glanville's defense of the moderns in the Plus Ultra, published in 1668. Jones suggests that the theory that nature was decaying created feelings of inferiority among sixteenth- and seventeenth-century scholars which encouraged them to seek security in ancient knowledge--in ideas expressed by more perfect men living in a more perfect world. Jones demonstrates this point by quoting, for example, from Godfrey Goodman's The Fall of Man, published in 1616.

> For all Arts whatsoeuer, the best authors are the most ancient, euen vnto this day: I could instance in euery one in particular, though wee building vpon their foundations, haue added some ornaments, yet such as are not necessarie to perfit the Art: and generally for the Ancients, whatsoeuer you shal obserue in practise amongst them, you shall find that it stood with great wisdome and prouidence, if you please to haue relation to the times and occasions.[26]

One of the goals of the Aristotelian scientists, then, was to preserve those traditional truths established by the superior philosophers of the past.

Bacon, however, envisioned a different goal for the scientist. He rejected the idea that one could discover truth by turning to authorities from the past.

> 'Tis the greatest Weakness to be attributing infinite Things to Authors, whilst we are refusing Justice to the Author of Authors, and all Authority; which is Time: for Truth is justly call'd the Daughter of Time, not of Authority. Whence 'tis no wonder, if these joint Fascinations, viz. of Authors, of Antiquity, and Consent, should so far bind the Faculties of Men as to keep them, like Persons possess'd, from conversing with Things themselves.[27]

He advocated, instead, a science whose goal was future human achievement.

> Another great Reason of the slow Progress of the Sciences, is this; that 'tis impossible to proceed well in a Course, where the End is not rightly fix'd and defined. Now the true and genuine End of the Sciences, is no other, than to enrich human Life with new Inventions, and new Powers; but much the greater Number of the Sciences produce nothing in this Kind; being mere Hirelings, and professorial . . .[28]

The potential for human progress through science, Bacon felt, was being stifled in the schools which were dominated by those who respected only ancient authors.

> Again; in the Customs and Institutions of Schools, Universities, Colleges, and the like Conventions, destin'd for the Seats of learned Men, and the Promotion of Knowledge, all Things are found opposite to the Advancement of the Sciences: for the Readings and Exercises are here so managed, that it cannot easily come into any one's Mind to think of Things out of the common Road. . . . For the Studies of Men in such Places are confin'd, and pinned down to the Writings of certain Authors; from which, if any Man happens to differ, he is presently reprehended as a Disturber and an Innovator.[29]

The way toward human progress was blocked by another institution, also. The Aristotelian philosophy had been assimilated into the Christian religion, and Bacon had to answer the criticisms of those who felt a new science would harm traditional religion. Once again, Sir Thomas Elyot provides an example of the firm connections between the Aristotelian philosophy and religious beliefs. In *The Boke Named the Governour*, Elyot tries to show that order in civil affairs is good by showing that God's creations are orderly and good.

> For as moche as Plebs in latin, and comminers in englisshe, be wordes only made for the discrepance of degrees, wherof procedeth ordre: whiche in thinges as wel naturall as supernaturall hath euer had suche a preeminence, that therby the incomprehensible maiestie of god, as it were by a bright leme of a torche or candel, is declared to the blynde inhabitantes of this worlde. . . . Beholde the foure elementes whereof the body of man is compacte, howe they be set in their places called spheris, higher or lower, accordynge to the soueraintie of theyr natures, that is to saye, the fyer as the most pure element, hauying in it nothing that is corruptible, in his place is higheste and aboue other elementes. The ayer, whiche next to the fyre is most pure in substance, is in the seconde sphere or place. The water, whiche is somewhat consolidate, and approcheth to corruption, is next unto the erthe. The erthe, whiche is of substance grosse and ponderous, is set of all elementes most lowest.[30]

One can see that Elyot's idea of God was dependent on his concept of order and that his idea of order in the physical universe was derived from the Aristotelian theory that there are four basic elements and that each has a natural place in the physical world.

Bacon argues that this traditional coupling of philosophy and religion is detrimental to the advance of both.

> We must not omit, that Natural Philosophy has, thro' all Ages, had a troublesome and difficult Adversary to contend with; viz. Superstition, and the blind, furious Zeal of Religion. . . .
>
> And, as Matters now stand, 'tis still more difficult and dangerous to discourse upon Nature, by reason of the Summaries and Methods of the scholastic Divines; who having imperiously reduced Theology to Order, and fashion'd it into an Art, have, at the same time, blended too much of the thorny and contentious Philosophy of Aristotle into the Body of Religion.
>
> And to this Head belongs, tho' in a different respect, the Labours of such as have ventured to deduce and confirm the Truth of the Christian Religion, from the Principles and Authorities of Philosophers . . . rashly and unequally intermixing Things divine and human. But in such Medlys of Divinity and Philosophy, only the

> Things at present receiv'd in Philosophy are comprehended; whilst new ones, tho' better, are almost quite rejected and excluded.[31]

The new philosophy, Bacon says, rather than harming religious truth, will increase man's faith in God.

> . . . whoever rightly considers it, will find, that Natural Philosophy is, next after the Word of God, the most certain Cure of Superstition; and the best Support of Faith. Philosophy, therefore, is deservedly appointed as the true Handmaid to Religion; the one manifesting the Will, and the other the Power of God. For 'twas no Error in him who said, Ye err, not knowing the Scriptures, and the Power of God: thus inseparably mixing, and joining together the Information of his Will, and the Knowledge of his Power. 'Tis, therefore, the less Wonder, that Natural Philosophy has been so little improved, when Religion, whose Power over Mens Minds is exceeding great, has, thro' the Ignorance and unwarrantable Zeal of some, been made to oppose it.[32]

Furthermore, Bacon says in another passage, Biblical prophecy indicates that as the earth grows older men will learn more. So, the new philosophy is obviously capable of furthering God's plan for the world.

> And we should here remember the Prophecy of Daniel, concerning the latter Ages of the World: Many shall go to and fro upon the Earth, and Knowledge shall be increased: Thereby plainly intimating it to be the Design of Providence, that when the World was laid open to a general Intercourse; as by our numerous long Voyages it now begins to be; at the same Time also the Sciences should receive Increase.[33]

Again, Bacon has exchanged one of the purposes of the Aristotelian scientist for a new goal conducive to the experimental philosophy. The Aristotelian scientist was one who used his knowledge to uphold traditional religion. The new philosopher, Bacon says, will discover truths which will increase men's knowledge of and awe of God.

> . . . let no one weakly imagine, that men can search too far, or be too well studied in the Book of God's word, and works, Divinity and Philosophy; but rather let them endeavour an endless progression in both; only applying all to charity, and not to pride; to use, not ostentation; without confounding the two different streams of Philosophy and Revelation together.[34]

In the early seventeenth century, then, the study of natural philosophy was controlled by those who followed the Aristotelian method. They were attracted to Aristotle because his philosophy provided a means for obtaining complete and certain knowledge and because faith in the validity of the system was strengthened by its associations with tradition and organized religion. In his works, Bacon proposed a system of experimental philosophy. He promised in the place of complete and certain knowledge, the increase of knowledge; in the place of tradition, progress; in the place of old religious associations, a new, more complete understanding of the deity.

ii

In 1638 a small book entitled *The Man in the Moone: or a Discourse of a Voyage thither by Domingo Gonsales, The Speedy Messenger* was published in London. Domingo Gonsales, the hero, narrator, and pretended author of the tale, is one of the first scientists to appear in literature. Significantly, he is not an Aristotelian. Rather, he is an inventor and a discoverer of new phenomena.

Though it appeared under the pseudonym of Domingo

Gonsales, The Man in the Moone has been attributed, with some certainty, to Francis Godwin, Bishop of Llandaff under Queen Elizabeth and Bishop of Hereford under James I. Anthony à Wood, in the Athenae Oxonienses, credited Godwin with The Man in the Moone and suggested that he wrote the book while he was a student at Oxford, between 1578 and 1584.[35] If this date were correct, of course, Godwin would have developed his ideas concerning experimental science independent of Bacon, who published The Advancement of Learning in 1605, the Novum Organum in 1620, and the Sylva Sylvarum in 1627.

In 1931, in an article published in the Review of English Studies, Harold W. Lawton demonstrated that certain historical information included in The Man in the Moone suggests a much later date of composition. Gonsales mentions, for example, the Battle of the Isle of Pines, which was fought in 1596, twelve years after Godwin left Oxford.[36] Gonsales also mentions Father Pantoja, a Jesuit missionary who lived in Pekin. Father Pantoja did not arrive in Pekin until 1601, and, unless Godwin had a private source of obtaining information about China, the earliest he could have known of Father Pantoja's work was 1604, when a letter from Pantoja was published in Spain. The most likely source that Godwin might have drawn on, however, for information concerning Jesuit activities in China was Purchas His Pilgrims, published in 1625.[37] Lawton suggests, then, that The

Man in the Moone was composed between 1625 and 1629.[38]

In an article published in Modern Philology in 1937, Grant McColley suggests that Bacon's Sylva Sylvarum was a probable source for certain scientific ideas which appear in Godwin's tale. He feels that Godwin probably conceived the idea for Gonsales's flying machine from a passage in which Bacon describes an experiment for flying suggested to him by a superstitious practice of the ancients. McColley quotes the following passage from Bacon:

> It is reported that amongst the Leucadians, in Ancient time, upon a Superstition, they did used to Precipitate a Man, from a High Cliffe into the Sea; Tying about him with Strings, at some distance, many great Fowles; And fixing unto his Body divers Feathers, spred to breake the Fall; Certainly many Birds of good Wing, (as Kites, and the like) would beare up a good Weight as they flie; And spreading of Feathers, thin and close, and in great Bredth, will likewise beare up a great Weight; Being even laid, without Tilting upon the Sides. The further Extension of this Experiment for Flying may be thought upon.[39]

In The Man in the Moone, Gonsales invents a machine which he uses to fly from place to place and, eventually, to fly to the moon. Using strings and pulleys, Gonsales constructs a device to which he ties 25 trained birds. Together they are able to lift him and carry him through the air. McColley points out that other sources of the myth Bacon mentions in the Sylva Sylvarum do not mention the use of string, an element which appears in both Bacon and Godwin. He also finds it significant that, like the Leucadians, Gonsales makes his first flight from a cliff over water.[40]

McColley also suggests Bacon as the probable source for Godwin's ideas about the nature of gravity. Gonsales found, as he flew toward the moon, that he reached a point where the birds no longer had to work to hold him up. "O incredible thing," he says, "they forbare moving any thing at all and yet remained unmoveable . . . the Lines slacked; neither I, nor the Engine moved at all, but abode still as having no manner of weight."[41] According to Aristotle, a body was always attracted toward its proper place in the universe. Gonsales's body and his engine, then, would have been attracted to the earth no matter how far from earth they were. Bacon, however, believed that the earth's power to attract a body became weaker as the body moved farther from the earth. To demonstrate this point, McColley quotes the following passage from Bacon.

> It is very probable that the Motion of Gravity worketh weakly, both farre from the Earth, and also within the Earth: The former, because of the Appetite of Union of Dense Bodies with the Earth, in respect of the distance, is more dull; The later, because the Body hath in part attained his Nature, when it is some Depth in the Earth. For as for the moving to a Point or place (which was the Opinion of the Ancients) it is a meere Vanity.[42]

As these two articles suggest, Godwin probably wrote The Man in the Moone in the late 1620's, and he was probably familiar with Bacon's works at the time he composed Gonsales's story. It seems also possible, then, that Godwin could have patterned his scientist figure after Bacon's concept of the experimental scientist.

The character of Domingo Gonsales, as he appears at the first of the book, depends less upon his scientific ideas than upon his nationality. Gonsales was born of noble parentage but, because he was the youngest of seventeen children, he inherited nothing. He was sent to the university at Salmanca to prepare to take a position in the church, but he left the university, selling his books and bedding, and went to Antwerp to fight with the Duke D'Alva. When he was in need of money he was not above acting ignobly, as, for example, when he defeated a horseman by "killing his Horse with my pistoll, which falling upon his leg, so as he could not stirre, hee yeelded himselfe to my mercie; but . . . seeing him a lustie tall fellow, /I/ thought it my surest way to dispatch him . . . "[43] The horseman's goods yielded Gonsales 200 ducats, and he reveals much about his character as he is presented in the early pages of the book when he says, "no sooner was that money in my purse, but I began to resume the remembrance of my nobility . . . "[44]

Eventually Gonsales acquired 3000 crowns and the daughter of a wealthy merchant, but just when his life seemed to be going well, he killed a man in a duel and had to flee to the East Indies, where he traded in jewels. On this voyage, while he is recuperating from an illness on the Island of Saint Helena, Gonsales's character changes. At this point in the story, most of his "Spanishness" disappears and he becomes, instead, an experimental scientist.

As such, he goes far toward illustrating Bacon's ideas of what the new scientist would be like.

Bacon had said that the scientist needed to be an inventor, that through "mechanical experience" he would obtain new powers over nature and thus new knowledge. Gonsales's interest in science begins when he becomes an inventor. When Gonsales is left on Saint Helena, he is accompanied only by a Negro servant named Diego. They decide that, in order to be able to find enough food, they will live on different sides of the island. They soon find, however, that they need some way to communicate with one another, and Gonsales begins to experiment with methods of sending messages across the island.

At first Gonsales trains partridges and a tame fox to carry notes tied around their necks. Not being totally satisfied with this system, he next tries communicating with signals of light at night and smoke or dust in the day. Eventually he decides to train Gansas--large carnivorous birds which are quite plentiful on the island. He trains thirty or forty young birds to fly to a white cloth. If either he or Diego wishes to call the birds, he simply unfurls a white sheet and the birds respond. Soon Gonsales has trained them to carry small bundles of food from one place to the other.

Gonsales then decides to try to get the birds to work together to carry heavier burdens, and he becomes an inventor in earnest.

> Having prevailed thus farre, I began to cast in my head how I might doe to joyne a number of them together in bearing of some great burthen: which if I could bring to passe, I might enable a man to fly and be carried in the ayre, to some certaine place safe and without hurt. In this cogitation having much laboured my wits, and made some triall, I found by experience, that if many were put to the bearing of one great burthen, by reason it was not possible all of them should rise together just in one instant, the first that raised himselfe upon his wings finding himselfe stayed by a weight heavier than hee could move or stirre, would by and by give over, as also would the second, third, and all the rest. I devised (therefore) at last a meanes how each of them might rise carrying his owne proportion of weight only . . . [45]

Using string and cork pulleys, Gonsales invents an engine that enables the Gansas to work together. He has them first carry an eight pound weight, then a lamb, and finally Gonsales himself.

> So upon a time having provided all things necessary, I placed my selfe with all my trinckets, upon the top of a rocke at the Rivers mouth, and putting my selfe at full Sea upon an Engine . . . I caused Diego to advance his Signall whereupon my Birds presently arose, 25 in number, and carried mee over lustily to the other rocke on the other side, being about a Quarter of a league.[46]

Once he has succeeded in flying, Gonsales is anxious to show his invention to the world, so he arranges to travel home with the next fleet that comes by Saint Helena. On the way to Spain the fleet is overtaken by English ships. While attempting to escape, the Captain of the ship Gonsales is on runs the ship into the rocks. Gonsales hastily arranges his Gansas and engine, and as the ship splits, the Gansas fly him to land, saving his life. But his adventures are far from over. On land, he is chased by savages and forced to turn his birds toward a snow covered mountain which he hopes they will think is one of his white signals.

> But what then, O Reader? . . . prepare thy selfe unto the hearing of the strangest Chance that ever happened to any mortall man, and that I know thou wilt not have the Grace to beleeve, till thou seest it seconded with Iteration of of /sic/ Experiments in the like, as many a one, I trust, thou mayest in short time . . . They . . . even as I began to settle my selfe for the taking of them in, as it were with one consent, rose up, and having no other place higher to make toward, to my unspeakeable feare and amazement strooke bolt upright . . .[47]

Gonsales is thus off on a trip to the moon where he will discover many things neither he nor any other man ever dreamed existed.

As an inventor, Gonsales had created a device that gave him a new power over nature. No man before him had experienced flight. Gonsales's invention provided practical benefits, of course. It helped to solve his communication problems, and it saved him from drowning and from the attack of the natives. But it also provided him with new, direct means of obtaining knowledge. Because he can fly, Gonsales can experience first-hand phenomena in the heavens. He discovers by experience that several of the Aristotelian theories were incorrect. Thus he moves from being simply an inventor to being a natural philosopher as well.

Gonsales's "experience" demonstrates to him that the Aristotelian philosophers are wrong about several things. As was mentioned above, Gonsales found that the attracting power of the earth diminished as he moved farther away from it.

> I found then by this Experience that which no Philosopher ever dreamed of, to wit, that those things which wee call heavie, do not sink toward the Center of the Earth, as their naturall place, but as drawen by a secret property of the Globe of the Earth, or rather some thing within the same, in like sort as the Loadstone draweth Iron, being within the compasse of the beames attractive.[48]

Of course, by the 1620's several philosophers, most notably William Gilbert, who published his De Magnete in 1600, had "dreamed" of the idea that the force of gravity was connected with magnetic attraction. Godwin carefully dates Gonsales's moon voyage, however, at 1599 so that he can claim to "discover" these phenomena.

During his flight to the moon, Gonsales also notices some interesting things about the upper atmosphere. He finds the space between the earth and the moon to be of a temperate climate, and thus concludes: "As for that imagination of the Philosophers, attributing heat together with moystnesse unto the ayre, I never esteemed it otherwise than a fancy."[49] Aristotle had attributed to air the qualities of heat and moisture. Gonsales thus thinks the sphere of air that he is traveling through should be hot, if the Aristotelian theory is correct. He finds, by his own experience, however, that this is not true.

Another reason why Gonsales, had he believed Aristotle, might have supposed that the upper atmosphere would be hot is that it was the natural place for the element of fire. Bacon had rejected the idea that a sphere of fire surrounded the earth, and Gonsales finds on his journey that he travels through no such sphere, again proving the Aristotelians to be wrong.

> Amongst many other of their vaine surmises, the time and order of my narration putteth me in mind of one which now my experience found most untrue.
> Who is there that hath not hitherto beleeved the uppermost Region of the Ayre to be extreame hot, as being next forsooth unto the naturall place of the Element of Fire.
> O Vanities, fansies, Dreames!
> . . . .
> As for that Region of Fire our Philosophers talke of, I heard no newes of it, mine eyes have sufficiently informed me there can be no such thing.[50]

By looking down on the earth as he flies above it, Gonsales discovers another important fact about the universe. He finds that the earth spins on its axis, as Copernicus suggested it did.

> Philosophers and Mathematicians I would should now confesse the wilfulnesse of their owne blindnesse. They have made the world beleeve hitherto, that the Earth hath no motion. And to make that good they are fain to attribute unto all and every of the celestial bodies, two motions quite contrary each to other . . .
> O incredible thing, that those same huge bodies of the fixed stars in the highest orbe, whereof divers are by themselves confessed to be more than one hundreth times as bigge as the whole earth, should as so many nayles in a Cart Wheele, be whirled about in that short space, whereas it is many thousands of Yeares . . . before that orb do finish his Course from West to East . . .[51]

So Gonsales reasons as he watches the earth, like a "huge Mathematicall Globe" turn before his eyes. But, after he concludes his arguments in favor of the Copernican system, Domingo realizes that he has been guilty of engaging in logical dispute, as the Aristotelians did, and he reprimands himself for it. "But where am I?" he says. "At the first I promised an History, and I fall into disputes before I am aware."[52]

Through his process of experiment and discovery, Gonsales has achieved profound things from a rather simple beginning. He begins his experiments in order to entertain himself and in order to solve a simple communication problem. He combines his relatively unsophisticated knowledge of natural history (the characteristics of the Gansas) and physics (the nature of the pulley) and invents a new machine. As a result of his invention, he is able to investigate nature in a new way and obtain knowledge through direct experience which is more accurate than the logical deductions of the ancients. This is, of course, exactly what Bacon suggested the new scientist would be able to do.

Bacon had proposed two goals for science. The first was that science would "enrich human Life with new Inventions, and new Powers." Gonsales also has a desire to aid mankind as well as himself. His invention, he feels, will work "to the unspeakeable good of all mortall men."

> may /it/ please God that I doe returne safe home againe into my Countrie, to give perfect instructions how those admirable devices, and past all credit of possibilitie, which I have light upon, may be imparted unto publique use. You shal then see men to flie from place to place in the ayre . . . you shall bee able to declare your minde presently unto your friend, being in some private and remote place of a populous Citie, with a number of such like things: but that which far surpasseth all the

> rest, you shall have notice of a new World, of many most rare and incredible secrets of Nature, that all the Philosophers of former ages could never so much as dreame off.[53]

Bacon also saw science as a means of fulfilling divine providence, and so did Gonsales. Domingo is certain that his life reflects God's will. When he leaves the university, and thus his chance for a position in the church, he says, "But our Lord purposing to use my service in matters of farre other nature and quality, inspired me with spending sometime in the warres."[54] Gonsales discovers, as a result of his voyage, a utopian society. The moon people, who seem to have a perfect relationship with both God and nature, also believe that God watches after mankind. Gonsales asks the moon people if they have discovered any way to make men invisible, and they reply,

> that if it were a thing faisible, yet they assured themselves that God would not suffer it to be revealed to us creatures subject to so many imperfections, being a thing so apt to be abused to ill purposes; and that was all I could get of them.[55]

Gonsales's discovery, then, not only yields a practical invention and new scientific knowledge, but also gives him a greater realization of God's glory and power.

Domingo Gonsales is an interesting character, but he certainly isn't a Frankenstein, even though he has the power to invent devices that may change the lives of men. Gonsales never questions the fact that his invention will be used for good by mankind. He has no sense of being responsible for his creations. He at times fears for his own safety, but he never questions the safety of mankind, for he feels he and his inventions are in the hands of his God, his church, and his state. Domingo trusts these forces which order his universe to care for a world of which he and his science are only a small part.

> But I must be advised, how I be over-liberall, in publishing these wonderfull mysteries, till the Sages of our State have considered how farre the use of these things may stand with the Policy and good government of our Countrey, as also with the Fathers of the Church, how the publication of them, may not prove prejudiciall to the affaires of the Catholique faith and Religion, which I am taught (by those wonders I have seen above any mortall man that hath lived in many ages past) with all my best endeavours to advance, without all respect of temporall good, and soe I hope I shall.[56]

It is obvious, of course, that Domingo Gonsales does not really experience any of the things recounted in The Man in the Moone, and Godwin does not expect the reader to believe he has. He tells the reader on the first page that the book is "an essay of Fancy" and that "It was not the Authors intention . . . to discourse thee into a beleife of each particular circumstance."[57] Godwin's tale is not the new science itself; it is rather the dream of the new science. He is trying to show the reader what exciting things might be discovered by a person who leaves the faulty Aristotelian method and follows the new experimental method. Godwin has grasped the dream of the new science, but he does not see all the implications of the dream. He sees the potential for reaching toward the stars and finding a utopia, but he does not see, behind the dream, the potential for nightmare.

Writers who followed Godwin, however, were not able even to envision the dream. It would be over a hundred years before another successful inventor appeared in a fictional work. In the meantime, Domingo Gonsales appeared in Cyrano de Bergerac's _Voyage to the Moon_ and in Thomas D'Urfey's _Wonders in the Sun_ playing another part, representing another response to the new science. He left the world of the dream and entered the realm of satire. No longer was he viewed as the adventurous experimental scientist, making discoveries to help mankind. Instead he was a ludicrous little Spaniard who pretended to be a philosopher, but whom the moon people mistook for an ape.[58]

Godwin believed in the new science though it had not yet proved itself. Those who followed him, however, were more skeptical, and they reflected their doubt through another scientist figure--the virtuoso.

CHAPTER II

THE VIRTUOSO: THE SCIENTIST WITH NO POWER

Sir Francis Bacon had said, in the Novum Organum, that one of the greatest difficulties the new philosophy would face was overcoming public doubt.

> But the greatest Obstacle of all, to the Progress of the Sciences, and the Understanding of new Tasks and Provinces in them, lies in the Despair of Mankind, and the Supposition of Impossibility. For prudent and exact Men, generally distrust such kind of Attempts; upon considering with themselves the Obscurity of Nature, the Shortness of Life, the Fallacy of the Senses, the Weakness of the Judgement, the Difficulties of Experimenting, etc.[1]

Bacon was, indeed, completely justified in his fears that the new science would be plagued by doubters. During the Restoration another view of the scientist appeared in various works of literature. By the 1680's a figure usually called the virtuoso had become a stock character used to represent certain abuses in learning. He appeared as a scientific dilettante who knew little and accomplished less. Sometimes he was an astronomer who thought he was observing fantastic battles on the moon; sometimes he was a microscopist who spent all his time studying lice, flies, and other undesirable insects; sometimes he was a physicist who was fascinated with weighing air, and often he was all of these and more. He was usually associated in some way with the members of the newly founded Royal Society, and often he was also associated with the alchemists and astrologers. He was consistently used to demonstrate that the scientists' dream of gaining new powers was false--that science, as it was being practiced by the followers of Bacon, could not advance knowledge, improve the lives of men with new inventions, or bring men closer to God by revealing His power.

The ridiculous character of the virtuoso which haunted the scientist from the pages of fiction and from the stage was one of the greatest obstacles which the advocates of the new philosophy faced. Thomas Sprat, one of the early defenders of the new science, realized the potential threat of such ridicule, and toward the end of the _History of the Royal Society_, he urged the "_Wits_ and _Railleurs_ of this _Age_, to reconcile their Opinions and Discourses to these _Studies_." In a passage which sounds almost like a plea for the development of a sympathetic science fiction genre, he continued,

> For now they may behold that their Interest is united with that of the _Royal Society_; and that if they shall decry the promoting of _Experiments_, they will deprive themselves of the most fertil Subject of _Fancy_ . . . I acknowledge that we ought to have a great dread of their power: I confess I believe that _New Philosophy_ need not (as _Caesar_) fear the pale, or the melancholy, as much as the humorous, and the merry: For they perhaps by making it ridiculous, becaus it is _new_, and becaus they themselves are unwilling to take pains about it, may do it more injury than all the Arguments of our severe and frowning and dogmatical _Adversaries_.[2]

Sprat suggested that the new science was being ridiculed simply because it was new. Of course, the conservative forces in any age will try to cause people to doubt new, untried ideas. This reaction was especially strong during the Restoration because the English had spent twenty years with Cromwell's new ideas, and they had reason to feel that his "experiments" in new government and new religion had not worked very well. And, though the new science did not begin to bear fruit until it received the support of Charles II during the Restoration, the seeds Bacon had planted budded and bloomed during the Commonwealth years. The Puritans took Bacon's dream and tried to make his ideas realities. In order to understand fully the early reactions to the new science--the reactions which led to the birth of the character of the virtuoso--one must first see the close association between the new philosophy and the Puritan beliefs.

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Using Richard Baxter's _Christian Directory_ as a source for Puritan doctrine, Robert K. Merton, in _Science, Technology and Society in Seventeenth Century England_, suggests several reasons why the new philosophy was attractive to the Puritan mind. First, the Puritans stressed social utilitarianism. They believed men should glorify God, and they felt the best way to accomplish that end was to serve mankind. By studying the sciences, the Puritans felt they could more fully understand and appreciate the power of God and, at the same time, increase their ability to use nature to improve the world. Their feelings concerning science were, then, almost identical to Bacon's and they were thus receptive to Bacon's ideas concerning scientific method.[3]

The result of the scientist's efforts, however, was not social gain alone. The personal reward Baxter describes is a wonderful pleasure that the scientist will derive from his work.

> Grace will become more notable and discernible [if you perservere and succeed in your labours] . . . For the very exercise of love to God and man, and of a heavenly mind and holy life, hath a sensible pleasure in itself, and delighteth the person who is so employed: as if a man were to take the comfort of his learning and wisdom, one way is by the discerning his learning and wisdom which he hath, in reading and meditating on some excellent books, and making discoveries of some mysterious excellencies in arts and sciences, which delight him more by the very acting, than a bare conclusion of his own learning in the general, would do. What delight had the inventors of the sea-chart and magnetic attraction, and of printing, and of guns, in their inventions! What pleasure had Galileo in his telescopes, in finding out the inequalities and shady parts of the moon, the Medicean planets, the 62 adjuncts of Saturn, the changes of Venus, the stars of the Milky Way, etc. . .[4]

So, Baxter says, any learning is good and will bring men pleasure, but the discovery of new things is the best sort of learning and carries along with it great feelings of delight and satisfaction.

The Puritan belief in predestination also attracted people to the new science. Those who held this belief felt that one's election was demonstrated by one's good works. Success in one's profession was often considered to be the outward sign of an inward grace. Thus the Puritans wanted to enter practical, serviceable professions and succeed. Baxter listed, in the order of their desirability, several professions which he considered to be good callings. He determined the order by the amount of public good which he felt resulted from each. Thus he listed the "learned professions" (with the exception of the ministry which required a special calling) first, followed by agriculture, trade, and crafts.[5]

Once again, by being actively engaged in a calling, the Puritan felt he aided both mankind and himself. He provided useful services for mankind, and he provided for himself the assurance of his salvation and a life so full of beneficial activity that he had little time to fall prey to temptation and sin.[6]

In order to prepare young people for these utilitarian professions, the Puritans stressed educational reform. Again, Bacon's ideas were often present in their proposed educational projects. As R. F. Jones points out in <u>Ancients and Moderns</u>, Bacon was a reformer, and his spirit perfectly matched the spirit of reform which marked every aspect of the Puritan Revolution.[7] There were numerous pamphlets written in the mid-seventeenth century concerning educational reform. One example is William Petty's "The Advice of W. P. to Mr. Samuel Hartlib, for the Advancement of Some Particular Parts of Learning," published in 1648. In this pamphlet, Petty, who was later one of the founding members of the

Royal Society, proposes a three-step plan for the advancement of learning, which, he hopes, will "shew where our own Shoe pincheth us" and "point at some Pieces of Knowledge, the Improvement whereof . . . would make much to the general Good and Comfort of all Mankind."[8]

The first step, Petty says, is to try to provide for the various areas of learning a body of effective laborers. Bacon, in the New Atlantis, had described a scientific utopia in which experimentation was carried on by a group of qualified scientists, working together to advance knowledge.[9] Petty also believes that science will be better advanced if scientists can communicate with each other about their problems and projects, their discoveries, and their ideas for new discoveries and inventions,

> to the End that, by such a general Communication of Designs, and mutual Assistance, the Wits and Endeavours of the World may no longer be as so many scattered Coals, or Firebrands, which for Want of Union are soon quenched, whereas, being but laid together, they would have yielded a comfortable Light and Heat.[10]

The next step, Petty feels, is to determine what ground has already been covered in the various branches of learning. He suggests that a group of men be appointed to compile a set of volumes which will collect all real or experimental learning from present books, "exploding whatsoever is nice, contentious, and merely fantastical."[11] This is, of course, the equivalent to the natural history Bacon urged philosophers to prepare.[12] Once this compilation has been prepared, Petty says, able men in each field of learning can work to increase knowledge without having to repeat work that has already been done.

The third step in the plan, however, is the most important to Petty. "And now," he says, "we shall think of Whetting our Tools, and Preparing sharp Instruments for this hard Work, by delivering our Thoughts concerning Education . . . ."[13]

Petty suggests the founding of three different types of institutions for the advancement of learning. The first will be "Ergastula Literaria, Literary Work-houses, where Children may be taught as well to do something toward their Living, as to read and write."[14] At this school all children, both rich and poor, above the age of seven will be educated so that, as Petty says, "the Business of Education be not, as now, committed to the worst and unworthiest of Men, but that it be seriously studied and practiced by the best and ablest Persons."[15]

Before they are taught to read and write, Petty says, the children will be taught "to observe and remember all sensible Objects and Actions."[16] Petty believes they will then have more worthwhile things to write and understand better what they read, after they are taught these skills. Each child will also be taught arithmetic, geometry, drawing, and designing. Furthermore, Petty says, "all Children, though of the highest Rank [will] be taught some genteel

Manufacture in their Minority . . ."[17] The benefits the children are to receive from this education are clearly intended to gratify the Puritan desire for piety, practicality, and public good.

> 1. They shall be less subject to be cozened by Artificers.
> 2. They will become more industrious in general.
> 3. They will certainly bring to pass most excellent Works, being, as Gentlemen, ambitious to excel ordinary Workmen.
> 4. They, being able to make Experiments themselves, may do it with less Charge, and more Care, than others will do it for them.
> 5. The Respublica Artium will be much advanced, when such, as are rich and able, are also willing to make luciferous Experiments.
> 6. It may engage them to be Mecaenates and Patrons of Arts.
> 7. It will keep them from worse Occasions of spending their Time and Estates.
> 8. As it will be a great Ornament in Prosperity, so it will be a great Refuge and Stay in Adversity and common Calamity.[18]

Petty's system of education was intended to help create a society of good Puritans. With its emphasis on teaching children to increase their powers of observation and to learn the mathematics and mechanical skills needed to perform experiments, Petty's system would have also produced a society of Baconian scientists.

Petty suggests that two other institutions be established. One is to be a Gymnasium Mechanicum or college of tradesmen. "From this Institution," Petty says,

> we may clearly hope, when the Excellent in all Arts are not only Neighbors, but intimate Friends and Brethren, united in a common Desire and Zeal to promote them, that all Trades will miraculously prosper, and new Inventions

> would be more frequent, than new Fashions of Cloaths and Household-stuff.[19]

The other proposed institution is to be a research hospital where physicians, surgeons, and apothecaries will work together to find cures for disease, for without health, Petty says, men will not be able to enjoy all the good things which will result from his other ideas.[20]

Petty's pamphlet demonstrates how thoroughly Bacon's ideas concerning the advancement of the sciences had become part of the Puritans' thoughts on educational reform. Petty freely acknowledges his indebtedness to Bacon. Toward the beginning of the pamphlet, for example, he says,

> To give an exact Definition, or nice Division of Learning, or of the Advancement thereof, we shall not undertake (it being already so accurately done by the great Lord Verulam) . . .[21]

A few paragraphs later, he cuts short his discussion on the necessity of providing ways for scholars to communicate by saying that Bacon, whom he calls the "Master-builder," has already "done it so solidly."[22]

It is important to realize that Petty had every intention of making his dream, or his version of Bacon's dream, a reality. He says that he is not writing a utopia; he is presenting what he hopes will prove to be a practical plan. Petty intended to finance his educational projects with money he hoped to receive from one of his inventions (a machine which allowed a scribe to make two copies of a document at once.)[23] His institutions, however, never came into being. Other early members of the Royal Society also tried to initiate practical educational reforms. In 1653, for example, John Wilkins, another staunch believer in Bacon's philosophy, gave £200 to help found a college for experiments and mechanics at Oxford. In 1657 he was still encouraging the idea of beginning such a school, but that dream also seems to have never become a reality.[24]

The early founders of the Royal Society were often men who dreamed of great changes and had high hopes, but it inevitably follows that they also faced frustrations, disappointments, and failures. They did succeed, however, in making one aspect of the dream a reality, first on a small scale and later, with the founding of the Royal Society, on a much larger scale.

Bacon had urged that the new science be a corporate affair. Aristotle's logical method required only the senses and the understanding of an individual mind, but Bacon's method of observation and experiment required the combined minds and senses of many people. Sprat explained this distinction between the two types of science in his _History of the Royal Society_.

> In brief, _disputing_ is a very good instrument, to sharpen mens wits, and to make them versatil, and wary defenders of the Principles, which they already know: but it can never much augment the _solid substance_ of _Science_ itself: And me thinks compar'd to _Experimenting_, it is like _Exercise_ to the Body in comparison of _Meat_: For running, walking, wrestling, shooting, and other such active sports, will keep men in health, and breath, and a vigorous temper: but it must be a supply of new food

> that must make them grow: so it is in this case; much contention, and strife of argument, will serve well to explain obscure things, and strengthen the weak, and give a good, sound, masculine colour, to the whole masse of knowledge: But it must be a continued addition of observations, which must nourish, and increase, and give new Blood, and flesh, to the *Arts* themselves.
> . . . .
> There are indeed some operations of the mind, which may be best perform'd by the simple strength of mens own particular thoughts . . . But there are other works also, which require as much aid, and as many hands, as can be found. And such is this of observation: Which is the great Foundation of Knowledge: Some must gather, some must bring, some separate, some examine . . . [25]

In order to further experimental science, then, groups of men began to meet to perform and discuss experiments. A group known as the invisible college or philosophical college began meeting in London around 1646. The members gathered weekly to "discourse and consider of *Philosophical Enquiries*, and such as related thereunto; as *Physick*, *Anatomy*, *Geometry*, *Astronomy*, *Navigation*, *Staticks*, *Magneticks*, *Chymicks*, *Mechanicks*, *and Natural Experiments*, with the State of these Studies, as then cultivated at home and abroad."[26]

Another group, the Oxford Experimental Science Club, was begun under the influence of John Wilkins, then Warden of Wadham College, Oxford (and, by the way, the brother-in-law of Oliver Cromwell), in 1649. Bacon's influence on Wilkins and the club was indicated by John Aubrey in his *Brief Lives*. About Wilkins, he says,

> He was the principall reviver of experimentall philosophy (secundum mentem domini Baconi) at Oxford, where he had weekely an experimentall philosophicall

> clubbe, which began 1649, and was the incunabula of the Royall Society.[27]

According to Sprat, the club met as frequently "as their affairs permitted" and made "Trials, in Chymistry, or Mechanicks."[28] These meetings continued until 1658 when changing affairs of state took many of the members to London. There a group was formed that met at Gresham College, an institution established through a bequest of Sir Thomas Gresham, the founder of the Royal Exchange, in which seven professors lived and read weekly lectures on astronomy, geometry, law, divinity, rhetoric and music. Christopher Wren and Laurence Rook, who had both been members of the Oxford group, had become lecturers at Gresham College, and others interested in natural philosophy began to meet with them there. In 1659, however, when the Puritan government collapsed, Gresham College was temporarily turned into a quarter for soldiers, and these meetings ceased to be held.[29]

In 1660 the Gresham College group, joined by a number of men who had returned from France with Charles II, began to meet again. On November 28, 1660 they decided to form a society which, when they received a royal charter two years later, was called the Royal Society. In 1663 a second charter lenghtened the group's legal title to "the Royal Society of London for Promoting Natural Knowledge." For years to come, public attention on science and the scientist would focus on this society.[30]

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The early skeptical reactions to the new science probably resulted, at least in part, from its Puritan associations. The Royal Society was governed by a council of 21 men. Each year the members of the society elected eleven men to continue on the council and ten men to serve as new council members. During the first ten years of the history of the society, nine men served almost continually on the governing council. At least four of them were rather closely associated with the Puritan movement.

John Wilkins, who because of his close associations with men interested in science was one of the most influential of the founding members, was, as I mentioned above, Oliver Cromwell's brother-in-law. Cromwell had made him Warden of Wadham College, and when Wilkins married, Cromwell gave him dispensation to continue in that position. (This was necessary since Wilkin's marriage violated the statutes of the college.) Under the leadership of Richard Cromwell, Wilkins became head of Trinity College, Cambridge.[31] Margery Purver, in The Royal Society: Concept and Creation, speculates that Wilkins would have been the first president of the Royal Society had he not had such close Puritan associations.[32]

Wilkin's friend Seth Ward, who later became Bishop of Salisbury, refused to join with the Puritans during the early years of the Civil War. In 1644, by refusing the covenant, he lost his fellowship at Cambridge. But in 1649 he took the oath to the English Commonwealth so he could become Savilian professor of astronomy at Oxford.[33] Just before the Restoration he was elected president of Trinity College, a position he reluctantly resigned when Charles II returned to England.[34]

Another of the early leaders of the Royal Society was John Goddard, who was also a friend of Wilkins both in London and at Oxford. Wood called Goddard a "great confidant" of Cromwell. He was the chief physician to the army during the Irish campaign of 1649 and the Scotch campaign of 1650-51. In 1651 Cromwell made him the warden of Merton College, Oxford. He lost that position at the Restoration and moved to Gresham College where he became the professor of physick. Of his association with the Royal Society, Wood says:

> He was also a zealous member of the royal society for the improvement of natural knowledge among them: and when any curious experiment was to be done, they made him their drudge till they could obtain to the bottom of it.[35]

Henry Oldenburg, the early secretary to the Royal Society, also had Puritan connections. Oldenburg was educated at the evangelical school at Bremen. Between 1640 and 1648 he was in England, where he gained "favour and respect from many distinguished gentlemen in Parliament." In 1653 he was asked by the Council of Bremen to negotiate with Cromwell for Bremen's neutrality in the war. This he did. In 1654 he became a friend and correspondent of John Milton, who was, at that time, Cromwell's Latin secretary. By 1656, Oldenburg also had made his way to Oxford and was meeting with Wilkins, Petty, and the rest of the Oxford Club.[36]

Of the other five men who were leaders of the Royal Society in its early years, two were definitely Royalists. One was William Brouncker, who was president of the Royal Society from 1662 until 1677. Brouncker spent the years of the Commonwealth privately studying mathematics. In 1660 he supported General Monk and was a member of the convention parliament of 1660.[37] According to Evelyn, Brouncker was nominated for the presidency of the Royal Society by Charles II, the Royal Founder.[38] Pepys, who was acquainted with Brouncker through their positions in the navy administration, once called him as "rotten-hearted, false man as any else I know."[39]

Robert Moray was a devoted Royalist who fought for both Charles I and Charles II. During the Commonwealth years, when he was not with the King, Moray lived as a recluse, studying chemistry. After the Restoration he returned to London and began meeting with the other philosophers there. He was a friend of Charles II and is said to have visited the King with some frequency in his laboratory at Whitehall.[40] Interestingly enough, Moray, though a Royalist, was "presbyterianly inclined." Yet, according to Wood, "he had the king's ear as much as any other person."[41]

There was, then, every reason for the public to associate the new science and the Royal Society with the Puritan movement. That at least some people did just that is illustrated by Robert South's notorious attack on the Royal Society. On July 9, 1669, at the opening of the Sheldonian Theatre at Oxford, Robert South, who was the public orator at Oxford, made what John Evelyn called "some malicious & undecent reflections on the Royal Society as underminers of the University."[42] The actual text of South's oration has been lost, but a telling description of the speech was preserved in a letter which John Wallis wrote to Robert Boyle.

> Dr. South, as university orator, made a long oration. The first part of which consisted of satyrical invectives against Cromwell, fanaticks, the Royal Society, and new philosophy; the next, of ecomiasticks, in praise of the archbishop, the theatre, the vice-chancellor, the architect, and the painter; the last, execrations against fanaticks, conventicles, comprehension, and new philosophy, damning them *ad infernos, ad gehennam*.[43]

As Margery Purver points out, Gilbert Sheldon, Archbishop of Canterbury and the donor of the building, and Christopher Wren, the architect, were both members of the Royal Society. But that did not seem to matter to South, who clearly associated the Royal Society and the new philosophy with Cromwell and the fanatics.[44]

In his History of the Royal Society, Thomas Sprat tried to defend the new society against those who were attacking it. Throughout much of the book he simply discusses the advantages of the new science over the old, but in several passages he also tries to firmly disassociate the new science from its Puritan heritage. He points out, for example, that enthusiasm has no place in science. In one passage he accuses the chemists who seek wealth through "the chase of the Philosopher's Stone" of being "downright Enthusiasts about it." He continues, "And seeing we cast Enthusiasm out of Divinity it self, we shall hardly sure be perswaded, to admit it into Philosophy."[45]

Sprat seems particularly eager to try to divorce the early Oxford Club from its Puritan associations. He thus pictures its members as a group of men stalwartly holding out against the "false spirit" of the age. They met at Oxford, he says, because it was a place where they could breath "a freer air . . . without being ingag'd in the passions, and madness of that dismal Age." There they taught young men "sober and generous knowledge"so they would be "invincibly arm'd against all the inchantments of Enthusiasm." There, and later at the meetings in London, they tried to forget the terrible misfortunes of the Civil War.

> For such a candid, and unpassionate company, as that was, and for such a gloomy season, what could have been a fitter Subject to pitch upon, then Natural Philosophy? . . . It was Nature alone, which could

> pleasantly entertain them, in that estate. The contemplation of that, draws our minds off from past, or present misfortunes, and makes them conquerers over things, in the greatest publick unhappiness: while the consideration of Men, and humane affairs, may affect us, with a thousand various disquites that never separates us into mortal Factions; that gives us room to differ, without animosity; and permits us, to raise contrary imaginations upon it, without any danger of a Civil War.[46]

Sprat is obviously coloring the truth in this passage to further his own cause, the public acceptance of the Royal Society. The meetings of the Oxford Club, as was pointed out above, provided support for the Puritan ethics, not an escape from them.

In another passage concerning the relationship between the Royal Society and religion, Sprat argues that the society is searching for those truths which apply to all men; its function is not to provide support for any particular religious sect. Thus, men from all countries, all professions, and all religions may be members of the Royal Society.[47] The society, he promises in a later passage, will not concern itself with matters of religion except to show how "the Power, and Wisdom, and Goodness of the Creator, is display'd in the admirable order, and workmanship of the Creatures. It cannot be deny'd, but it lies in the Natural Philosophers hands, best to advance that part of Divinity."[48]

Even though Sprat tries to separate the Royal Society from its Puritan background and stress its interdenominational appeal, his concept of the purpose of the new science remains very close to that of Bacon and the Puritans. The principal goal of science, Sprat says, is to improve the world in which we live. Though the new scientists do not intend to study God or the soul, which are aspects only of religion,

> In all the rest, they wander, at their pleasure: In the frame of Mens bodies, the ways for strong, healthful, and long life: In the Arts of Mens Hands, those that either necessity, convenience, or delight have produc'd: In the works of Nature, their helps, their varieties, redundancies, and defects: and in bringing all these to the uses of humane Society.[49]

Its lack of practical application, Sprat argues, led to the destruction of the old philosophy. The Aristotelian philosophy was utterly useless, in respect to the good of mankind, Sprat says, and so it was destroyed by the barbarians while the useful arts, such as cooking, plowing, making iron and steel, were preserved.[50] This, however, is not to be the fate of the new philosophy. The new scientists will build a mountain from their knowledge of everything in the universe, even the most insignificant. Then, "standing on the top of them, we may perfectly behold all that are below, and make them all serviceable to the quiet, and peace, and plenty of Man's life."[51] So, like Bacon and the Puritans, Sprat stresses that science must be useful; it must produce things that will improve life.

Sprat felt that another benefit which could come from the new science would be a better understanding of God. In this he also reflects the beliefs of both Bacon and the

Puritans. Standing on the mountain he has built from his observations of nature, Sprat says, the new philosopher will be nearer to heaven.

> And to this happiness [serving mankind], there can be nothing else added: but that we make a second advantage of this rising ground, thereby to look the nearer into heaven: An ambition, which though it was punish'd in the old World, by an universal Confusion; when it was manag'd with impiety, and insolence; yet, when it is carried on by that humility and innocence, which can never be separated from true knowledg; when it is design'd not to brave the Creator of all things, but to admire him the more: it must needs be the utmost perfection of humane Nature.[52]

So, though the advocates of the new philosophy tried to shake off the Puritan associations which had become connected to Baconian ideals, they did not deviate from those goals Bacon had set out for the scientist to pursue. They believed that, through experimentation, they could discover new knowledge that would provide both practical and spiritual helps for mankind.

-iii-

The defenders of the new philosophy were promising great things, the same great things, in some cases, that the Puritans had promised. It is not odd, then, that their efforts were greeted with skepticism and ridicule. The new philosophers claimed that men had powers they had not yet tapped and that they could use these powers to improve the world. The satirist painted a picture of a scientist who thought he had power but, in reality, was powerless--

even to see his own stupidity.

The character of the virtuoso, the powerless scientist, was developed in such works as The Description of a New World Called the Blazing World, by Margaret Cavendish, Duchess of Newcastle; Hudibras and "The Elephant In the Moon," by Samuel Butler; and The Virtuoso, by Thomas Shadwell. These writers, though firm Royalists,[53] were not conservative Aristotelians fighting in defense of the old philosophy. In fact, Aristotelians are also ridiculed in their works.[54] Those who satirized the new science included it as one of many abuses of the age--abuses in learning, in government, and in religion. Their theme was the limitation of man, his great potential for imperfection, and his folly for not realizing his weakness and behaving accordingly.

One of the earliest fictional pictures of the new scientist appeared in The Description of a New World Called the Blazing World, by Margaret Cavendish, Duchess of Newcastle. The Duchess, who considered herself somewhat of a philosopher, published The Description of a New World in 1666, when the Royal Society had been in existence four years. This was, by the way, two years before her famous visit to the Royal Society, which Pepys describes in his Diary.[55] The Duchess said that the work was partly romantical, partly philosophical, and partly fantastical. It was, however, also partly satirical.

The Description of a New World is the story of a virtuous woman who is kidnapped by evil sailors. Their ship encounters a tempest and is blown toward the North Pole. En route, all the evil sailors freeze to death, but the woman, because of her great virtue, is spared. When the ship reaches the North Pole, it is blown into another world, called the Blazing World, which is a utopia inhabited by intelligent animals and humans of various bizarre colors. The people of the land are at peace because they have one monarch, believe in one God, and have one form of worship. The philosophy of government is that the most simple alternative is always the best, and, when the woman arrives, the idea seems to be working admirably.

The Emperor of the Blazing World falls in love with the virtuous woman and marries her. The new Empress, who has a great love of learning, decides to erect schools to encourage the study of the arts and sciences. She appoints different animals to study the disciplines most suited to their species. Both the old and the new sciences are represented in the disciplines they study. The bird men are astronomers; the spider and lice men, mathematicians; and the jackdaw, magpie, and parrot men are orators and logicians. The fly, worm, and fish men are natural philosophers, the bear men are experimental philosophers, and the ape men are chemists.

When the Empress visits her philosophers to see how they are progressing, she finds that, rather than accumulating knowledge, they have simply started disputes among themselves. The bird-astronomers argue over the cause of the sun's light, the reason why the sun and moon appear in different shapes and sizes, and the reason for the motes of the sun. The Empress soon tires of their arguments and appeals to the bear men, who represent the new experimental philosophers, to solve the disputes of the astronomers by looking through their telescopes. But, rather than stopping the astronomers' arguments by presenting the truth, the bear men only add to the problem, for they each see different things through their telescopes and they each explain what they have seen differently. The Empress becomes very angry, and says:

> now I do plainly perceive, that your Glasses are false Informers, and instead of discovering the Truth, delude your Senses; Wherefore I Command you to break them, and let the Bird-men trust onely to their natural eyes, and examine Coelestial Objects by the motions of their own Sense and Reason. . . . Nature has made your Sense and Reason more regular than Art has your Glasses; for they are meer deluders and will never lead you to the knowledg of Truth.[56]

Obviously, this passage is an attempt to refute Bacon's argument against Aristotelian science. He had said that natural sense and reason were not capable of finding truth, that men had to invent tools, like the telescope, to improve the senses. The Duchess argues, however, that the most simple method, in this case the unaided sense of sight, is as capable of finding truth as the more complex use of the telescope.

The more biting satire in this passage, however, appears in the bear men's answer. They kneel in front of the Empress and beg her to allow them to keep their telescopes,

> for, said they, we take more delight in Artificial delusions, than in Natural truths. Besides, we shall want Imployments for our Senses, and Subjects for Arguments; for, were there nothing but truth, and no falshood, there would be no occasion to dispute, and by this means we should want the aim and pleasure of our endeavours in confuting and contradicting each other; neither would one man be thought wiser than another, but all would be alike knowing and wise, or all would be fools; wherefore we most humbly beseech your Imperial Majesty to spare our glasses, which are our only delight, and as dear to us as our lives.[57]

The Empress consents, on the condition that "their disputes and quarrels should remain within their Schools, and cause no factions or disturbances in State, or Government."[58]

The Duchess is not trying to show that the Aristotelian science is better than the new philosophy, for neither the birds nor the bears are able to establish anything that they will all agree is true. The difficulty in finding truth, the Duchess says, lies not in the method one uses but in the imperfection of man. Neither the Aristotelian nor the Baconian will find truth, because men enjoy disputing and will find reasons to argue about phenomena, whether they be vague or clear.

This passage illustrates one important aspect of the character of the powerless scientist--he is not able to discover truth. He enjoys being deluded by ideas which are false either because, like the Aristotelian, his happiness depends on his finding ways to win an argument, or because he finds his false ideas more wonderful, more awe inspiring, than the truth would be.

Samuel Butler's astrologer, Sidrophel, who represents the new philosopher in Hudibras, is one who seeks wonderful new truths. He mistakes a lattern hung to a kite for the planet Saturn, because his desire to discover something new--that Saturn has completely left its natural orbit--is so great that it causes him to pass over the more reasonable explanation for the sight he sees.

The desire to discover something new and fantastic is also characteristic of the scientists in Butler's short satirical poem, "The Elephant in the Moon."[59] Members of the Royal Society, Butler shows, are so eager to be amazed that they are overcome with wonder before they are told what is supposed to be amazing. After the first virtuoso looks through the telescope and cries out "Strange," the rest,

> Surpriz'd with Wonder, beforehand,
> At what they did not understand,
> Cry'd out, impatient to know what
> The Matter was, they wonder'd at.[60]

They all believe, when they look through the telescope, that they are seeing a battle on the moon and that, in the midst of this battle, they view a giant elephant. Believing their original conclusion to be true, they arrive at many very logical explanations for the phenomena, and they begin planning an article to publish in the next issue of the Philosophical Transactions. While they are discussing the text of their article, however, one of the servants looks through the telescope and suggests that a mouse has gotten into the tube. This leads to a great dispute, not only over the truth of the phenomenon--whether they are seeing an elephant or a mouse--but also over the relative importance of the truth, for they know they need to make an outstanding discovery to win public favor.

> This said, the whole Assembly allow'd
> The Doctrine to be right, and good;
> And, from the Truth of what th' had heard,
> Resolv'd to give Truth no Regard,
> But, what was for their Turn, to vouch,
> And either find, or make it such:
> That 'twas more noble to create
> Things like Truth, out of strong Conceit,
> Than, with vexatious Pains and Doubt,
> To find, or think t' have found her out.[61]

After more lengthy debate, they decide that the only way to settle the dispute is to open the tube and see what is inside. To their dismay, they find that the great armies they thought they observed on the moon were really only swarms of gnats and flies, and the elephant was, indeed, only a mouse. So, Butler says, their only discovery for the evening was:

> That those who greedily pursue
> Things wonderful, instead of true;
> That in their Speculations chuse
> To make Discoveries strange News;
> And Nat'ral History a Gazette
> Of Tales stupendous, and far-fet;

Hold no Truth worthy to be known,
That is not huge, and over-grown,
And explicate Appearances,
Not as they are, but as they please,
In vain strive Nature to suborn,
And, for their Pains, are paid with Scorn.[62]

Like the bears in the Blazing World, these Royal Society members found neither unity among themselves nor truth. Like Sidrophel, their desire to discover the wonderful led them away from truth rather than toward it. All of these scientists are limited not by their physical senses but by their foolishness and their moral blindness. Ambitious to prove their intellectual power by making new discoveries, they lose their desire to recognize truth. No instrument in the world, no matter how much it improves man's ability to experience phenomena, can, according to the satirist, help men see who are blinded by such ambitions.

This particular criticism of the virtuoso, as we have seen, was usually associated with his use of instruments, particularly the microscope and the telescope. The satire probably resulted, in part, from the fact that the microscope and telescope had become social toys for the wealthy, and these instruments mystified many people who did not know how to use them. In August 1664, for example, when Samuel Pepys first got his microscope, he recorded in his Diary:

> After dinner up to my chamber and made an end of Dr. Power's booke of the Microscope, very fine and to my content, and then my wife and I with great pleasure, but with great difficulty before we could come to find the manner of seeing any thing by my microscope.[63]

There was, then, reason for some to question whether one could see better with the microscope or telescope than with the naked eye.

A passage from Shadwell's The Virtuoso gives a clue to another possible reason for the satire on the scientist's ability to discover new truths. At one point in the play, Snarl, the conservative defender of the old age, says to Sir Nicholas Gimcrack, the virtuoso:

> Pox! Let me see you invent anything so useful as a mousetrap, and I'll believe some of your lies. Prithee, did not a fellow cheat thee with eggs which he pretended were laid with hairs in them, and you gave him ten shillings apiece for the eggs till I discover'd they were put in at a hole made by a very fine needle.[64]

During the early years of the Royal Society, the members were plagued with hoaxes like the one which Snarl describes. It is impossible to know how many such frauds, discovered or undiscovered, were perpetrated against the society. Certainly one suspects accounts in the minutes which seriously describe seemingly impossible events. For example, on one occasion several members of the Royal Society saw a woman who claimed to have had a live child in her uterus for twenty years. She allowed the men to view the child's body, and as Birch reports in his History of the Royal Society,

> The members present, upon viewing the same, and taking notice of the remarkable particulars, judged it to be a very rare and wonderful production.[65]

Two tricks discovered by society members will demonstrate the lengths to which some people went to try to fool the new scientists. At the April 1, 1685 meeting of the Royal Society, Dr. Lister mentioned a hoax discovered by Francis Willughby. A woman had come to him claiming to have worms in her teeth which she would remove with a quill. Having reason to suspect her, Willughby forced the quill from her hands before she could put it into her mouth and discovered that she had hidden worms in the quill which she then pretended to pull from her teeth.[66]

In 1687, the Dublin Society was involved in an even more bizarre hoax. On November 16, the members of the society reported that they had seen a child whose eyes produced grain. The grain, they wrote, trickled in a small stream from the child's eyelids. On December 14, however, they reported that they had deduced from experiment that they had been tricked. They had discovered that one could easily force pieces of grain under the eyelid which would trickle slowly out. This, they supposed, was what the father of the child had done.[67]

If one adds to the problem of hoaxes the policy of the Royal Society to try to settle every possible question concerning nature by trial or observation, one sees that there was ample opportunity for the society, in the midst of its search for knowledge, to look ridiculous. The members of the society submitted to experiment many folk beliefs. They investigated stones that were said to remove the effects of poison. They performed various experiments with May dew and unicorn's horn to see whether these substances had special powers. By performing these experiments, of course, they were coming closer to certain truths. But to the casual observer, these experiments did not seem to be leading toward new powers for man or a more glorious vision of God.

The other criticism of the new philosophy which appeared in The Description of a New World and, to an extent, in "The Elephant In the Moon," was that it also created disputes. This particular criticism is not leveled against the scientist represented by later virtuoso characters, though one can find some grounds in the history of the Royal Society for such criticism. Perhaps later writers felt that a certain undesirable incongruity would occur in a character who was so credulous that he would believe anything and who was, at the same time, willing to engage in long disputes over particular theories. Of the two traits--credulity and argumentativeness--it was the former that most appealed to Thomas Shadwell. The plot of The Virtuoso depends on Gimcrack's ability to believe almost anything he is told. Longvil and Bruce, who are young gentlemen who wish only to pursue Gimcrack's nieces, convince him that they are, like him, great philosophers pursuing knowledge and truth. Since he believes them to be learned men, Sir Nicholas blatantly accepts as truth anything they tell him. So, when Longvil introduces into a conversation on spiders a totally fictitious spider which he calls the "tumbler," Sir Nicholas immediately pretends knowledge of it.

> Longvil.
> But above all, your tumbler spider is most admirable.
> Sir Nicholas.
> O sir, I am no stranger to't. It catches flies as tumblers do conies.

This answer leads Longvil and Bruce to observe:

> Bruce /to Longvil/.
> Good! How these fools will meet a lie halfway.
> Longvil /to Bruce/.
> Great liars are always civil in that point. As there is no lie too great for their telling, so there's none too great for their believing.[68]

In a later passage, during a discussion concerning microscopic creatures, Sir Nicholas observes that the creatures in vinegar "have sharp stings in their tails." Bruce answers, "Then certainly the sharpness or biting of vinegar proceeds from those stings striking upon the tongue." Sir Nicholas immediately accepts this theory as absolute truth.[69]

So, the satirists claimed that the scientists' promise that they would discover new truths was one they could not keep, because men who are willing to believe anything cannot possibly separate truth from falsehood and error.

The other claim of the scientists, that they could use their knowledge to improve the human condition, also created opportunities for satire. Just as the scientist was powerless to discover new truths, so he was powerless to invent new devices to help men. Again, one of the earliest examples of the scientist powerless to help mankind appears in The Description of a New World, by the Duchess of Newcastle. During the Empress's visit to her philosophers, she looks through a microscope and observes a flea and a louse. She asks the philosophers whether, through the use of the microscope, they can "hinder them biting, or at least show some means how to avoid them." But they answer "That such Arts [are] mechanical and below that noble study of Microscopical observations."[70] So the Empress discovers that her philosophers really are not interested in discovering practical applications for their discoveries.

As she continued questioning the philosophers, the Empress found that none of her scientists were engaged in useful activities. She dismissed the geometers because, she said, they weighed and measured such small things that they could not possibly agree. She stopped the logicians in the middle of their argument because she decided such artificial reasoning "disorders Men's understandings more than it rectifies them, and leads them into a Labyrinth whence they'l never get out, and makes them dull and unfit for useful employments." And, she became so bored with the chemists' discussions on primal matter that she finally told them to be quiet.[71]

The Empress's philosophers produce neither truth nor practical suggestions. They do, however, have the power to produce discord. The Empress allows her philosophers to continue their senseless studies because they derive pleasure from them, but, toward the end of the book, she discovers that this was a mistake. Disputes break out among the scientists that threaten the peace of the utopia. The Duchess of Newcastle, who by the end of the book has herself become a character in the story, advises the Empress to return the country to the original system--one sovereign, one religion, one law, one language--and to dissolve the trouble-making societies.

> I would advise your Majesty to dissolve all their Societies; for 'tis better to be without their intelligences, then to have an unquiet and disorderly Government. The truth is, said she, wheresoever Learning is, there is most commonly also Controversie and quarrelling; for there be always some that will know more, and be wiser then others: Some think their arguments Come nearer to Truth, and are more rational than others; Some are so wedded to their own opinions, that they'l never yield to Reason; and others, though they find their Opinions not firmly grounded upon Reason, yet, for fear of receiving some disgrace by altering them, will nevertheless maintain them against all sense and reason, which must needs breed factions in their Schools, which at last break into open Wars, and draw sometimes an utter ruin upon a State or Government.[72]

The Duchess did not believe, then, in scientific progress--a progress initiated by men. She did believe, however, that the natural world would continually improve. The Empress dissolves the useless societies, and she finds that this does not hinder the progress of her country. The Blazing World, established with its peaceful government, becomes better and better as the natural phenomena in the world increase. The Empress continues her studies of natural causes and effects, but she uses neither the old method nor the new--neither formal logic nor experimentation. She understands nature by depending only on her natural ability to reason, her common sense.

Butler also complained about the lack of practicality of the new science. In the Characters, he accused the virtuoso of refusing to consider the plain, easy things which are also the most useful. The virtuoso, he said, "delights most in attempting Things beyond his Reach, and the greater Distance he shoots at, the further he is sure to be off his Mark."[73] The virtuosos in "The Elephant In the Moon," rather than trying to improve things around them on earth, dream of establishing a colony on the moon. They are studying the moon, Butler suggests, to prepare for this great endeavor.

> A Learn'd Society of late,
> The Glory of a foreign State,
> Agreed, upon a Summer's Night,
> To search the Moon by her own Light;
> To take an Invent'ry of all
> Her real Estate, and personal;
> . . . .
> T' observe her Country, how 'twas planted,
> With what sh' abounded most, or wanted;
> And make the proper'st Observations,
> For settling of new Plantations,
> If the Society should incline
> T' attempt so glorious a Design.[74]

As in this case, the satirist often portrayed the virtuoso as a man who failed to make simple improvements in the world because he preferred to attempt ridiculously impossible things. It is interesting to note what things the satirists felt were obviously impossible, since many of them are now part of our lives. It is, I think, particularly difficult for us to appreciate this type of satire, since we are accustomed to the attitude that all things are possible, and since we have experienced the actualization of many "impossible" things.

A particularly good example of this satirical device is found in an anonymous poem entitled "In praise of the choice company of Philosophers and Witts who meet on Wednesdays weekly, at Gresham College," composed sometime before 1663. This satirist finds it difficult to believe, for example, that the Royal Society members can invent a diving bell which will allow a man to breathe underwater.

> A wondrous Engin is contriveing,
> In forme 'tis said much like a bell,
> Most usefull for the Art of Diveing,
> If't hitt t'will prove a miracle;
> For, gentlemen, 'tis noe small matter
> To make a man breath under water.[75]

The satirist also ridicules Evelyn's suggestions of ways to clean the London air, Wilkins' proposals for the development of a universal language, and the work of several society members who were trying to discover a way to measure longitude, all of which were very practical ideas, but all of which the satirist felt were impossible. He concludes the poem with this skeptical stanza:

> These are the things with many more
> Which miraculous appere to men
> The Colledge intend, the like before
> Never were done nor will be again
> And to conclude in Ballett fashion
> God bless the King and this new Corporation.[76]

There was, of course, some justification for this skeptcism. The early members of the Royal Society perfected none of the projects mentioned in the poem. It was almost a hundred years before men could adequately measure longitude, it was over two hundred years before the diving bell was perfected, there is still no universal language, and the air is still not as clean as we would like it to be.

Shadwell, who in Sir Nicholas Gimcrack created the most thoroughly developed virtuoso character of this period, also satirized the new philosophy by having his scientist dream of doing impossible things while in reality he accomplished nothing. Sir Nicholas says he has learned to fly and hopes to be able to fly to the moon. As he boasts:

> A man by art may appropriate any element to himself. You know a great many virtuosos that can fly, but I am so much advanc'd in the art of flying that I can already outfly that ponderous animal call'd a bustard, nor should any greyhound in England catch me in the calmest day before I get upon wing. Nay I doubt not but in a little time to improve the art so far, 'twill be as common to buy a pair of wings to fly to the world in the moon as to buy a pair of wax boots to ride into Sussex with.[77]

Sir Nicholas has other achievements to his credit, also. He has learned to bottle air so that, by simply opening a bottle in his chamber, he can enjoy country air in the city. He has improved the stentrophonical tube so that he can hear things being said eight miles away, and he believes "but in three months to improve it so, that from the chief mountain, hill, or eminence in a county a man may be heard round the county."[78]

Even as Gimcrack brags of his accomplishments, however, the reader's belief in his achievements is being undermined by the comments which Longvil and Bruce, the characters in the play who have the most sense and are the most successful in their enterprises, make in their asides. They think, in short, that Sir Nicholas is a madman. After he has described the wonders he has seen on the moon (he has viewed not only elephants and fighting armies, but also camels, public buildings, castles, and ships sailing on the lunar seas), Bruce and Longvil exchange these remarks:

> Bruce [to Longvil].
> No fanatic that has lost his wits in revelation is so mad as this fool.
> Longvil [to Bruce].
> You are mistaken. This is but a faint copy to some originals among the tribe.[79]

Belief in Sir Nicholas's actual ability to make practical improvements is also undermined by his own admission that he is not interested in the practical aspects of philosophy. Just as the scientists in the Blazing World profess that considering practical applications of the microscope is below them, so Sir Nicholas is only interested in the speculative part of philosophy. We are made aware of this when we first see Sir Nicholas, sprawled on a table in his laboratory, trying to imitate the swimming motions of a frog. After watching him awhile, Bruce asks if he ever tries to swim in the water, and the following exchange takes place.

Sir Nicholas.
Never, sir. I hate the water. I never come upon the water, sir.
Longvil.
Then there will be no use of swimming.
Sir Nicholas.
I content myself with the speculative part of swimming; I care not for the practic. I seldom bring anything to use; 'tis not my way. Knowledge is my ultimate end.[80]

Later in the play, Sir Nicholas reaffirms the fact that he has really accomplished nothing. When a group of ribbon weavers, angry over the invention of the engine loom, storm his house, Sir Nicholas cries out, "I protest and vow they wrong me. I never invented anything of use in my life, as Gad shall mend me, not I."[81]

So, say the satirists, the virtuosos have failed in the other part of the scientist's promise also. They are not capable of producing inventions which will help mankind because they dream too high and look too low. They dream impossible dreams of flights to the moon while they study the most insignificant and useless things in nature.

The early minutes of the Royal Society show that its members were also worried at times about their lack of organization and productivity. On the one hand, Bacon and Sprat had both warned scientists against trying to turn their experiments to profit too soon. Bacon compared this procedure to Atalanta losing the race to gain the golden apples.[82] Sprat argues that the society must consist mainly of gentlemen to help prevent this "corruption of learning."

> The first of these /corruptions of learning/ may be call'd, the marrying of Arts too soon; and putting them to generation, before they come to be of Age; and has been the cause of much inconvenience. It weakens their strength; It makes an unhappy disproportion in their increase; while not the best, but the most gainfull of them florish: But above all, it diminishes that very profit for which men strive. It busies them about possessing some petty prize; while Nature it self, with all its mighty Treasures, slips from them: and so they are serv'd like some foolish Guards; who, while they were earnest in picking up some small Money, that the Prisoner drop'd out of his Pocket, let the Prisoner himself escape, from whom they might have got a great randsom.[83]

On the other hand, however, there was public opinion--and the public was not patient. If the new science was really going to improve the world, they thought they should see some proof of it. Perhaps the most forceful criticism came from the Royal Patron himself. Though Charles II supported the Royal Society, he certainly did not mind joking about their efforts. Pepys recorded one such incident in his Diary in February 1664.

> Thence to White Hall; where, in the Duke's chamber, the King came and stayed an hour or two laughing at Sir W. Petty, who was there about his boat; and at Gresham College in general; at which poor Petty was, I perceive, at some loss; but did argue discreetly, and bear the unreasonable follies of the King's objections and other bystanders with great discretion . . . Gresham College /the King/ mightily laughed at, for spending time only in weighing of ayre, and doing nothing else since they sat.[84]

Though Pepys, who was, of course, a member of the Royal Society himself, says that the King's objections were unreasonable, the Royal Society did seem to be having trouble getting effectively organized. The society met once a week, except for a summer recess, and the members expected to be entertained with experiments, though most of them were unwilling to perform experiments themselves. Robert Hooke, the curator of the society, usually demonstrated several experiments at a meeting, and Henry Oldenburg, the secretary, read letters which he received from philosophers abroad or in other parts of England. The society's efforts to involve more than a small handful of men in its work, however, failed time after time. This was, I think, particularly frustrating to Oldenburg, who was sending reports of the society's discoveries to his foreign correspondents. In November 1664, he wrote a letter to Boyle describing a particularly successful meeting of the society, in which he said:

> And no question this Society would prove a mighty and important body, if they had but any competent stock to carry on their designs; and if all the members thereof could but be induced to contribute every one their part and talent for the growth, health, and welfare of their own body; which, methinks, is one of the most reasonable things in the world, and consequently should be easy to be persuaded to those, that make profession of reason and virtue.[85]

Oldenburg was definitely worried about the progress which the young society was making toward its goals. He was also worried that the society would be damaged by unfavorable criticism before it succeeded in demonstrating its worth. In December 1664, in another letter to Boyle, he commented on the dedication to the Royal Society in Joseph Glanville's latest edition of <u>The Vanity of Dogmatizing</u>, a defense of the new science.

> I was very glad, and so were others, to find to be so well understood at last by some, though, I fear, the great expectation he raiseth of their enterprise may be of more prejudice than advantage to them, if they be not competently endowed with a revenue to carry on their undertakings.[86]

As Oldenburg suggests, the Royal Society's leaders were having trouble getting money. They were, however, also having trouble getting their procedure for experimentation organized. A few quotes from Birch's History of the Royal Society will demonstrate how persistent a problem this was.

On December 4, 1666, Birch wrote,

> Sir Robert Moray proposed, that the council would take into consideration, how the experiments at the public meetings of the society might best be carried on; whether by a continued series of experiments, taking in collateral ones, as they were offered, or by going on in that promiscuous way, which had hitherto obtained.[87]

On February 1, 1668/9,

> It was moved by Mr. Oldenburg, that the council would think upon an effectual way of carrying on the business of experiments at the meetings of the society . . .[88]

The president appointed two committees to consider and direct experiments at the meetings. In February 1670/71, another aspect of the same problem was discussed.

> It being observed, that very many things were begun at the society, but very few of them prosecuted, Mr. Oldenburg offered to bring in a list of such particulars, which he was desired to do with speed.[89]

In 1674, they decided to solve the problem of member participation by requiring each member either to present a program or to pay £40 each year. This, however, was an idle threat and the penalty was not enforced. The council presented this suggestion after the president urged them to "meet, and consider of a better way than hitherto had been used, to provide good entertainment for the said meetings, by establishing lectures grounded upon, and tending to experiments."[90]

Again, on March 6, 1675/76, the problem of providing experiments for the meetings was discussed.

> The president moved, that it might be considered how to provide for the weekly meetings of the Society a sufficient number of experiments to be made from time to time, and to pitch upon such persons, as might be depended upon for the exhibiting of them.[91]

Again, a committee was formed to consider the problem.

In January 1679/80, twenty years after the Royal Society was established, they were still trying to discover a method for conducting experiments.

> . . . it was discoursed what was the best method of prosecuting experiments; and it was propounded by the president, that the best way was to proceed . . . by first making the proposition what was designed to be proved, and then proceeding with the experiments to make the proof.[92]

That members of the Royal Society were still interested in proving the usefulness of the new science is demonstrated by Sir William Petty's remarks on this occasion.

> Sir William Petty likewise mentioned it as a very desirable thing, that every member of the society would have some aim or design for promoting the ends of the society; and that he would do something in order to prosecute such design: and he wished, that the members would principally aim at such experiments or observations, as might prove of great and immediate use.[93]

The members of the Royal Society had not forgotten the goals they had set for themselves--the goals of discovering new knowledge and using it to help mankind that they had obtained from reading Bacon. But they did seem to find it very difficult to achieve these goals.

Looking back on the early Royal Society from a perspective of over three hundred years, we are impressed by what its members were able to envision. We look not at what these men were doing, but at what they said could be done, things other men since, in many cases, have done. The members of the Royal Society dreamed of flying, of safe underwater diving, of blood transfusions, but it was over 200 years before any of these became practical innovations. The seventeenth-century man viewed the Royal Society from a different perspective. He saw a group of amateur scientists who got together once a week to view experiments, many of which were rather messy and unpleasant to watch, who listened to papers containing ideas that many of them did not understand, whose meetings often disintegrated into an exchange of home remedies, who, on at least three occasions, refused to help with proposed practical projects, and who were themselves bothered by how little they were able to accomplish.[94] The skepticism of the seventeenth-century satirists was, I think, quite understandable and quite justified. They recognized the incongruity between what the scientist dreamed and what he did and found it laughable. The scientist, they discovered, claimed to have certain powers that he did not have. Because he lacked power, he was not a dangerous man, not one to be feared. He had gained no knowledge that significantly changed people's lives. And, though a number of the Royal Society members were close to Charles II, who supported the society even while he laughed at it, experimental science was still too closely associated with Puritanism for the scientist to have political or moral power. The Duchess of Newcastle's fear that scientific disputes would disrupt government seemed to be groundless. The only power the scientist did seem to have, in fact, was the power to hurt himself through his foolishness.

Sir Nicholas's exclusive love for science proves to be his ruin. At the end of the play, his estates are seized by the instrument makers who have constructed the costly devices he needed for his experiments, and he is completely deserted by his family and friends. For a brief moment, Sir Nicholas sees the error of his ways and laments, "That I should know men no better! I would I had studied mankind instead of spiders and insects."[95] The scientist hurts himself, then, by wasting his time in profitless study instead of accepting the limits of man and learning to live in the world.

On those occasions when Shadwell does approach the problem of the dangers of science and technology, he quickly retreats to other matters. When Snarl claims, for example, that Sir Nicholas has killed four or five madmen with his blood transfusion experiments, Bruce stands up for the virtuoso. "/Snarl's/ in the wrong in abusing transfusion," he says, "for excellent experiments may be made in changing one creature into the nature of another."[96] Shadwell does not seem really to fear that a mad scientist might kill men by performing experiments on them.

Later in the play, Shadwell touches on another potential danger of science, unemployment resulting from industrialization. The ribbon weavers storm Sir Nicholas's house because Snarl has told them that Sir Nicholas invented the engine loom that put them out of work. Again, this problem is not developed into a major theme of the play. Not only does Sir Nicholas claim to have never invented anything so practical as an engine loom, but the main satirical thrust of the passage is not directed at the virtuoso but at Sir Formal Trifle, the orator, who thinks he can calm the crowd with his florid rhetoric.

One reason, I feel, that the satirist did not fear the scientist and did not seriously consider his claims was that, to men like Butler and Shadwell, the scientist appeared to be only a glorified alchemist. They assumed that, after the interest in science generated by the Royal Society waned, the men who claimed to be new philosophers would go back to being astrologists and alchemists. Butler, for example, compares Sidrophel to a dog turning a spit who must continually walk in a circle. Sidrophel might occasionally rise to science, but, limited by the weight of his human nature, he will always eventually fall back to "Juggle, Cant, and Cheat."

> He had been long t'wards _Mathematicks_,
> _Opticks_, _Philosophy_, and _Staticks_,
> _Magick_, _Horoscopie_, _Astrologie_,
> He was _old Dog_ at _Physiologie_:
> But, as a _Dog_ that turns the spit,
> Bestirs himself, and plys his feet,
> To clime the _Wheel_; but all in vain,
> His own weight brings him down again:
> And still he's in the self same place,
> Where at his setting out he was.
> So in the _Circle_ of the _Arts_
> Did he advance his nat'rall Parts;
> Till falling back still, for retreat,
> He fell to _Juggle_, _Cant_, and _Cheat_ . . .[97]

At the end of _The Virtuoso_, Sir Nicholas also returns to his role of alchemist. Instead of reforming from his foolishness, he runs off to search for the philosopher's stone. He says:

> Am I deserted by all? Well, now 'tis time to study for use. I will presently find out the philosopher's stone. I had like to have gotten it last year but that I wanted May dew, being a dry season.[98]

This speech is particularly significant because it is the last thing Sir Nicholas says in the play. When Sir Nicholas finally turns his mind away from philosophical speculation, it is only to run after the same useless mirages that the alchemists had chased for years. Sir Nicholas, when he becomes disillusioned with his new dreams, simply returns to the old, and both, says Shadwell, are visions without substance.

Again, the satirist had some justification for associating the new science with alchemy and astrology. In the seventeenth century, it was not unreligious to believe in these magical arts, so it is in no way contradictory to suggest that the new science had roots in both Puritanism and alchemy and astrology. Sir Robert Moray, for example, who was a devout Protestant, was a patron of Thomas Vaughan, one of the prominent seventeenth-century alchemists.[99] Elias Ashmole, an early member of the Royal Society and a famous antiquary, once wrote in his Diary:

> One Hor. post merid. it pleased God to put me in Mind, that I was now placed in the Condition I always desired, which was That I might be enabled to live to my self and Studies; without being forced to take Pains for a Livelihood in the World: And seeing I am thus retired, According to my Heart's Desire, I beseech God to bless me in my Retirement, and to prosper my Studies, that I may faithfully and diligently serve him, and in all things submit to his Will; and for the Peace and Happiness I enjoy (in the Midst of bad Times) to render him all humble Thanks, and for what I attain to in the course of my Studies, to give him the Glory.[100]

This statement obviously comes from a very religious man, yet later passages in the diary show that among the things Ashmole seriously studied were both astronomy and astrology.

Perhaps most telling is the fact that Sir William Petty in his pamphlet on the advancement of learning suggests that the steward of his research hospital should be an astrologer. He says:

> But, as to the Advancement of Physick, we desire /the steward/ may be skilled in the best Rules of judicial Astrology, which he may apply to calculate the Events of Diseases, and prognosticate of the Weather; to the

> End that, by his judicious and careful Experiments, the Wheat may be separated from the Chaff in that Faculty likewise; and what is good therein may be applied to good Uses, and the rest exploded.[101]

The early history of the Royal Society shows that the members were willing to consider certain alchemical claims which they had no reason to believe were not possible. At one time, as I mentioned, they performed a number of experiments on May dew, though, by all accounts, they were trying to discover its physical, not its magical, properties.[102] But, though some of the members of the Royal Society were interested in alchemy and astrology, the society itself was scientific. A reading of Birch demonstrates that the members were not engaged in the exacting physical and spiritual process which the alchemists believed was necessary to achieve the philosopher's stone, nor were they casting horoscopes and predicting the future. The satirist's tendency to associate the new science with alchemy came, I think, from the fact that the alchemists, like the Puritans, had produced little more than great dreams.

As the Royal Society became weaker, the satirical associations between the scientist and the alchemist became stronger. In 1687, during a period when interest in the Royal Society was at an all time low, Aphra Behn's comedy The Emperor of the Moon was first produced in London. It contained a scientist character notable for his complete gullibility and his desire to be associated not with a scientific society but with a Rosicrusian Order. He was one of the most foolish scientist characters to appear in literature during the Restoration and eighteenth century, but also one of the most popular. _The London Stage_ lists at least 126 performances of _The Emperor of the Moon_ between 1687 and 1748.

By 1687, the Royal Society had lost quite a bit of its original gusto. Several of its strongest original supporters, including the Royal founder, Charles II, had died. Among these were Bishop Wilkins (d. 1672), Henry Oldenburg (d. 1677), Robert Moray (d. 1673), and William Brouncker (d. 1684). Brouncker had stepped down from the presidency in 1677, after serving for fifteen years. The presidents who followed him, though men dedicated to the Royal Society, did not seem to have the power of leadership necessary to direct the society successfully. Between 1677, when Brouncker resigned, and 1690, when Robert Southwell became president, the average number of members of the Royal Society per year dropped from 215 to 115. The decline in membership added to the financial difficulties which the society faced almost continually in its early years, and by 1687 the society was so deeply in debt that the council discussed selling the society's stock in the East India Company. During this period, publication of the _Philosophical Transactions_ was erratic. From 1677-78 and from 1687-90 the work whose purpose, at least in part, was to demonstrate what society members were accomplishing was not published. Not only did the society have trouble financing the publication, but also the editors of the Transactions had difficulty finding enough mateiial to put in the journal.[103]

To the casual observer, I think, it seemed that the satirists had been correct. The interest in experimental science appeared to have been a passing fancy, for the dream had failed to materialize. By 1687 Aphra Behn was urging the foolish, gullible scientists to return to the world of "Reason, common Sense, and right Religion."[104]

Dr. Baliardo, the scientist in The Emperor of the Moon, like Nicholas Gimcrack and nearly all the virtuoso characters that followed him, is a domestic character. Like Sir Nicholas, he is an over-protective guardian whose efforts to keep his daughter and niece from romantic involvement are successfully circumvented by two young noblemen. Like his predecessors, Baliardo is made gullible by his fascination with science. He wants to believe that there is a fabulous new world on the moon, and he will accept anything he is told which supports this theory. So, the young lovers are able to trick him into letting them marry by telling him that they are moon men.

Baliardo demonstrates his complete gullibility in several ways. First, he cannot distinguish fact from fiction. The virtuoso has been infected with a sort of moon madness; he is so fascinated with his studies of the moon that he hardly considers anything else. Most of his information about the moon, however, has come from moon-voyage fiction, not from scientific studies. When asked how Baliardo first became interested in the moon, Elaria, the doctor's daughter, replies:

> With reading foolish Books, Lucian's Dialogue of the Lofty Traveller, who flew up to the Moon, and thence to Heaven; an heroick Business, call'd The Man in the Moon, if you'll believe a Spaniard, who was carried thither, upon an Engine drawn by wild Geese; with another Philosophical Piece, A Discourse of the World in the Moon; with a thousand other ridiculous Volumes too hard to name.[105]

Only one of these works, John Wilkins' Discourse of the World in the Moon, is philosophical rather than fictitious, yet Baliardo believes all of them are true. The "Emperor" he longs to see throughout the play is Ironozar, a ruler whom Gonsales meets on his voyage to the moon. Charmante, one of the young noblemen, explains that the Emperor will travel from the moon to the earth with the help of an Ebula, a stone with strange magnetical properties which enables it to add or subtract weight from any body it touched. Domingo Gonsales had told of receiving an Ebula and several other almost magical stones from the people on the moon. Baliardo accepts Charmante's fantastic story because he has believed Godwin. He has lost his ability, then, to distinguish between imaginative works and philosophical ones.

Another sign of Baliardo's gullibility is that he cannot separate science from alchemy. Baliardo is not associated with a scientific society. In order to gain the doctor's confidence at the beginning of the play, Charmante comes to him from the "great Caballa of Eutopia," and tempts him with hinted promises of membership in the "Rosycrusian Order." Their conversation concerns the "Daemons of the Air" and the demi-gods which reside in the four elements--the sylphs, salamanders, nymphs and gnomes. The doctor's spiritual purity and his appeal to "Alikin, the Spirit of the East" enables him to "see" the moon beings, according to the philosophy Charmante uses to trick him--a philosophy which comes from "Count Gabalis; or the Extravagant mysteries of the Cabalists," an alchemical work, not a scientific one.[106]

Because he cannot distinguish fact from fiction or science from alchemy, Baliardo is easily tricked by the noblemen. Like the scientists gazing through the telescope in "The Elephant In the Moon," he never suspects that the wonders he sees are on earth, in his telescope, rather than on the moon. After "seeing" the Emperor of the moon (a picture Charmante attaches to the end of the telescope), the doctor believes he has been given empirical evidence which validates his theories, and he will believe anything Charmante tells him concerning the marvelous moon beings. When he catches the lovers having a party on a night when they had purposefully tried to lure him from town, they easily convince him that the Emperor had descended to earth and was visiting them in their dreams. Finally, Baliardo's gullibility makes it possible for the lovers to stage the "farce" which ends the play--a spectacular marriage between the supposed Emperor of the Moon and his friend the Prince of Thunderland and the doctor's two wards, whom he gladly gives in marriage to men he believes are from the moon.

Like the virtuosos before him, Baliardo's impossible dreams cause him to lose touch with reality. Unlike the others, however, Baliardo is cured of his malady--his moon madness. As was pointed out above, Nicholas Gimcrack briefly sees his folly, but does not leave it. At the end of the play, having lost everything, he wanders off in search of the philosopher's stone. Baliardo, on the other hand, learns the lesson that his friends intended to teach him through their elaborate trick. He decides that his books "are the Fantoms of Mad Brains, to puzzel Fools withal." And, at the end of the play he orders:

> Burn all my Books and let my study blaze, Burn all to Ashes, and be sure the Wind Scatter the vile contagious monstrous Lyes. . . .
> I see there's nothing in Philosophy--------
> Of all that writ, he was the wisest Bard, who spoke this mighty Truth-------
> "He that knew all that ever Learning writ,
> "Knew only this--that he knew nothing yet.[107]

So, Baliardo returns, after his flight to the world of lunatics, to the world of "Reason, common Sense, and right Religion." Perhaps, as the Royal Society grew less active, this is what its critics believed was happening. The day of the Royal Society, however, had by no means ended.

-iv-

The first public response to the scientist's dream of power and progress was a somewhat justifiable disbelief reflected in the powerless scientist who regressed into the still more foolish alchemist figure. Early virtuoso characters demonstrated the satirists' disbelief in experimental scientists as a group. In the eighteenth century, as the scientists slowly began to gain the power Bacon had dreamed of, the virtuoso character became less useful. New characters were created to represent more powerful, though not always less foolish, philosophers. During the eighteenth century the virtuoso figure was used by satirists, on occasion, to criticize those philosophers who hoarded masses of natural objects--stones, insects, plants--in the name of science. The new virtuoso was not the foolish studier of nature, he was merely the foolish collector of it.[108]

Two Tatler papers which were published in August and September, 1710, contain a picture of the collector-virtuoso. In Tatler No. 216, Addison publishes the will of Sir Nicholas Gimcrack. Rather than losing all his money to instrument makers, as Shadwell's virtuoso had, this Sir Nicholas has spent all his money collecting natural rarities, which are all he has to leave to his family. So in his will he bequeaths,

> <u>Imprimis</u>, to my dear wife,
> One box of butterflies,
> One drawer of shells,
> A female skeleton,
> A dried cockatrice.
> <u>Item</u>, to my daughter Elizabeth,
> My receipt for preserving dead caterpillars.
> As also my preparations of winter May-dew, and embryo pickle.
>
> . . . .
>
> <u>Item</u>, to my learned and worthy friend Dr. Johannes Elscrikius, Professor in Anatomy, and my associate in the studies of nature, as an eternal monument of my affection and friendship for him, I bequeath
> My rat's testicles, and
> Whale's pizzle,
> to him and his issue male; and in default of such issue in the said Dr. Elscrikius, then to return to my executor and his heirs for ever.[109]

That Addison does not intend to criticize all aspects of natural philosophy or all scientists is indicated in the opening paragraphs of the paper.

> Nature is full of wonders; every atom is a standing miracle, and endowed with such qualities as could not be impressed on it by a power and wisdom less than infinite. For this reason, I would not discourage any searches that are made into the most minute and trivial parts of the creation. However, since the world abounds in the noblest fields of speculation, it is, methinks, the mark of a little genius to be wholly conversant among insects, reptiles, animalcules, and those trifling rarities that furnish out the apartment of a virtuoso.[110]

Addison obviously believes that some scientists can use their philosophy to demonstrate God's power and glory. His virtuoso character is used to satirize those scientists whose activities do not lead toward this goal. The collector fails, Addison says, because his values are not proportioned correctly. He values the insignificant parts of nature too much and fails to value more important things.

For example, he says the virtuoso loses sight of practical common knowledge as he pursues a knowledge of trivial things.

> There are some men whose heads are so oddly turned this way, that though they are utter strangers to the common occurrences of life, they are able to discover the sex of a cockle, or describe the generation of a mite, in all its circumstances. They are so little versed in the world, that they scarce know a horse from an ox; but at the same time will tell you, with a great deal of gravity, that a flea is a rhinoceros, and a snail an hermaphrodite.[111]

Like the original Sir Nicholas Gimcrack,who failed to learn about human nature because he was too busy studying philosophy, this virtuoso is criticized not for what he has learned, but for what he has failed to learn about life.

Like Sir Nicholas, this virtuoso also loses his understanding of the common system of monetary value. He hoards spiders and toads as though they were money or jewels. He will spend twenty crowns for a beetle, a hundred crowns for a special toad.

Finally, Addison's Sir Nicholas loses sight of the most basic value of all--his love for his own life. In a later Tatler paper, No. 221, Addison describes Sir Nicholas's death. It seems poor Nicholas, ever chasing after his dreams, had run five miles on a hot summer day in pursuit of a special butterfly he wished to add to his collection. As a result, he caught a violent fever and died.[112] Sir Nicholas's dream, significantly, was not the dream of Bacon. Nicholas was not dreaming of finding new knowledge or gaining new powers--he was dreaming of completing his butterfly collection.

Addison's concern seems to be that the reputation of experimental science as a whole will be damaged by those who are straying away from the true goals of philosophy. He is not even really criticizing the hobby of collecting; he is criticizing men who treat collecting as a serious occupation and pretend that it is science.

> I would not have a scholar wholly unacquainted with these secrets and curiosities of nature; but certainly the mind of man, that is capable of so much higher contemplations, should not be altogether fixed upon such mean and disproportioned objects. Observations of this kind are apt to alienate us too much from the knowledge of the world, and to make us serious upon trifles, by which means they expose philosophy to the ridicule of the witty, and contempt of the ignorant. In short, studies of this nature should be the diversions, relaxations, and amusements; not the care, business, and concern of life.[113]

The virtuoso-collector appeared in several other works in the eighteenth century, also. The virtuosos in Alexander Pope's New Dunciad, for example, are collectors of weeds, shells, and other natural objects. They honor the Queen of Dullness by naming flowers for her and by catching a "peerless Butterfly" for her.[114]

A virtuoso also appeared in Samuel Johnson's Rambler papers. In No. 82 the virtuoso, Quisquilius, tells the story of his life. Even as a child, he says, he was curious about nature. As a young man, he began collecting natural objects--rocks, plants, butterflies and other insects, and all sorts of animals. As his mania for collecting grew, he turned to more challenging collecting. His hoard of rarities soon included "a snail that has crawled upon the wall of China; a humming bird which an American princess wore in her ear; the tooth of an elephant who carried the queen of Siam,"[115] and so on. Eventually, his passion for curiosities resulted in his bankruptcy, and, in order to pay his debts, he was forced to sell his "priceless" collections.

In the following Rambler paper Johnson indicates, as Addison had in the Tatler, that he is criticizing the virtuoso not for being a scientist but for being a relatively useless scientist. Again, this criticism of useless or powerless science can be seen as support for the new philosophy, which stressed the duty of the scientist to produce things that would benefit mankind. Johnson willingly supports any search for knowledge that provides some help, either practical or moral, for men. As he says in Rambler No. 83,

> There are, indeed, many subjects of study which seem but remotely allied to useful knowledge, and of little importance to happiness or virtue; nor is it easy to forbear some sallies of merriment, or expressions of pity, when we see a man wrinkled with attention, and emaciated with solicitude in the investigation of questions, of which, without visible inconvenience, the world may expire in ignorance. Yet it is dangerous to discourage well-intended labours, or innocent curiosity; for he who is employed in searches, which by any deduction of consequences tend to the benefit of life, is surely laudable, in comparison of those who spend their time in counteracting happiness, and filling the world with wrong and danger, confusion and remorse. No man can perform so little as not to have reason to congratulate himself on his merits, when he beholds the multitudes that live in total idleness, and have never yet endeavoured to be useful.[116]

Furthermore, Johnson urges those who are seriously searching after new knowledge to continue their efforts even though they do not clearly see where their study is leading. This supports Bacon's philosophy that the sciences must progress slowly--that in time a small discovery can yield great benefits. Johnson says, then,

> It is impossible to determine the limits of enquiry, or to foresee what consequences a new discovery may produce. He who suffers not his faculties to lie torpid, has a chance, whatever be his employment, of doing good to his fellow-creatures. The man that first ranged the woods in search of medicinal springs, or climbed the mountains for salutary plants, has undoubtedly merited the gratitude of posterity, how much soever his frequent miscarriages might excite the scorn of his contemporaries. If what appears little be universally despised, nothing greater can be attained, for all that is great was at first little, and rose to its present bulk by gradual accessions, and accumulated labours.[117]

Johnson is also willing to support certain types of collecting that yield benefits. A collection of natural objects in the hands of a serious philosopher, he says, provides a beneficial knowledge of the ways of nature as a whole and a greater appreciation of God.

> Those who lay out time or money in assembling matter for contemplation, are doubtless entitled to some degree of respect, though in a flight of gaiety it be easy to ridicule their treasure, or in a fit of sullenness to despise it. A man who thinks only on the particular object before him, goes not away much illuminated by having enjoyed the privilage of handling the tooth of a shark, or the paw of a white bear; yet there is nothing more worthy of admiration to a philosophical eye, than the structure of animals, by which they are qualified to support life in the elements or climates to which they are appropriated; and of all natural bodies it must be generally confessed, that they exhibit evidences of infinite wisdom, bear their testimony to the supreme reason, and excite in the mind new raptures of gratitude, and new incentives to piety.[118]

Johnson also approves of making collections of mechanical objects to demonstrate how men have progressed and thus to encourage others to continue their studies.

> To collect the productions of art, and examples of mechanical science or manual ability, is unquestionably useful, even when the things themselves are of small importance, because it is always advantageous to know how far the human powers have proceeded, and how much experience has found to be within the reach of diligence.[119]

The least useful sort of collecting, Johnson says, is the gathering of rarities "which owe their worth merely to accident, and which can convey no information, nor satisfy any rational desire."[120] So, he sees little use in collecting fragments of ancient artifacts of the belongings of once-famous men, though, even in this case, he refuses to deem the activity utterly worthless if it encourages virtue or satisfies curiosity.

But, though he recognizes a certain virtue in collecting, Johnson feels many men waste time in this activity that they could spend in more productive inquiries. This, he feels, is the real harm in the mania for collecting.

> The virtuoso therefore cannot be said to be wholly useless; but perhaps he may be sometimes culpable for confining himself to business below his genius, and losing in petty speculations, those hours by which if he had spent them in nobler studies, he might have given new light to the intellectual world. It is never without grief, that I find a man capable of ratiocination or invention enlisting himself in this secondary class of learning; for when he has once discovered a method of gratifying his desire of eminence by expence rather than by labour, and known the sweets of a life blest at once with the ease of idleness, and the reputation of knowledge, he will not easily be brought to undergo

> again the toil of thinking, or leave his toys and trinkets for arguments and principles, arguments which require circumspection and vigilance, and principles which cannot be obtained but by the drudgery of meditation.[121]

Johnson is here reflecting complete support of Bacon's philosophy. Bacon had compared those who merely collect knowledge with ants who gather stores for their own good but produce nothing from them.[122] Bacon felt that observation and experimentation should lead to new theories to be tested and new knowledge to be used by men. This is the activity of the complete scientist. Johnson says that a man capable of being a complete scientist should not be satisfied by performing only half of the scientist's task any more than a man who builds great buildings should be satisfied simply to gather lumber and nails.

The virtuoso character, then, was first used to criticize the goals of the new science but later was used to support them. In each case, the virtuoso figures are useless or powerless men, but the reason for their weakness is different. The virtuoso of the Restoration failed because his dreams were too large. The critics felt that limited men were not capable of achieving the wonders they envisioned. The critics of Baconian science felt that men were not able to discover new knowledge, to invent new sources of power, or to understand God more fully through his creation. In the eighteenth century, however, the virtuoso was pictured as a man whose dreams were too small. Johnson believed in the new philosophy. He felt that men could discover new things, improve the world, increase piety through science. He supported the new science by satirizing those whose dreams were limited, whose vision ended at the point where their collections ceased, whose power to help society, as a result, was also negligible.

Neither the Restoration nor the eighteenth-century virtuoso was a frightening character because neither had power. Neither could really help society, but neither could harm it much either. Virtuoso characters occasionally caused domestic problems for those around them, but because they were foolish, the other characters usually overcame whatever difficulties the virtuosos caused them.

During the eighteenth-century, however, as it became obvious that science might really become a source of power for men, characters appeared who had certain powers, though not necessarily scientific ones. One such character was the projector, a figure who had the political power to change society without the scientific power to create. He was thus both foolish and, to some extent, dangerous, for he tore down old things without having the power to build new ones.

CHAPTER III

THE PROJECTOR: THE SCIENTIST WITH POLITICAL POWER

In the early eighteenth century another satirized scientist character, usually called the projector, began to appear in literature. One might be tempted to look at the projector as the same character as the virtuoso, renamed to fit the vocabulary of a new century. Both terms are used to refer to foolish scientists whose dreams are greater than their abilities. The difference between the two figures is important, however. The virtuoso is most often depicted as a domestic, private character, but the projector is a public figure. The virtuoso followed his fancy to the detriment of his own life and fortune; the projector was able to threaten the lives and fortunes of numerous innocent people through his foolish speculations.

The projector was not always a scientist. Anyone who developed a fantastic moneymaking scheme, whether it was based on a scientific idea or not, was called a projector. On numerous occasions, however, the figure was used to satirize science. Jonathan Swift, in the "Voyage to Laputa" in _Gulliver's Travels_, uses the projector figure to satirize the scientist who unsuccessfully tried to use his knowledge to improve nature or to develop helpful mechanical inventions. More important, Swift uses both the projectors of Balnibarbi and the scientists of Laputa to show the dangers of mixing science with politics. His scientists had gained enough political power to initiate destructive changes in the world, and so they were no longer harmless characters. As writers began to realize that scientists did have power, even if it was not scientific power, they became more interested in discussing the scientists' moral obligations. Anyone who has the power to initiate change is responsible for whatever destruction he causes, they felt.

During the late seventeenth and early eighteenth centuries, scientists did, in fact, become more politically and economically influential. Members of the Royal Society were consciously electing politically powerful men to the presidency. At the same time, a number of individual scientists were involving themselves in political affairs. The projector figure arose out of the blending of political, economic, and scientific influences that occurred as England became more commercial and industrial.

In order to understand the projector, we must see how the character was used to criticize commercialism and political irresponsibility and how the scientist became associated with the businessman and the politician. We can then note how Swift and other satirists used the projector to criticize scientists who not only failed to make advances in science but also failed to be responsible for their failures.

-i-

In section iv of *A Tale of a Tub*, published in 1704, Swift wrote of Peter:

> To support this Grandeur . . . After much Thought, he cast about at last, to turn *Projector* and *Virtuoso*, wherein he so well succeeded, that many famous Discoveries, Projects and Machines, which bear great Vogue and Practice at present in the World, are owing entirely to *Lord Peter's* Invention.[1]

In the following pages Swift satirizes both the Catholic church and the growing commercialism in England by presenting Peter as a schemer who makes money by selling worthless items or services to the public.

Swift refers to Peter as both a projector and a virtuoso. As a virtuoso, Peter played the part of the foolish scientist. As a projector, he invented commercial schemes.

Of course, each of Peter's projects carries an allegorical meaning, but each also corresponds to a general type of business endeavor. Peter first attempted to make money by selling worthless foreign land. He purchased a "Large Continent, lately said to have been discovered in *Terra Australis incognita*," (a reference to Purgatory), which he sold "to certain Dealers, who carried over Colonies, but were all Shipwreckt in the Voyage. Upon which, *Lord Peter* sold the said Continent to other Customers *again*, and *again*, and again, and again, with the same Success."[2] Another of Peter's tricks was to sell worthless insurance. He sold fire insurance for "Tobacco-Pipes, Martyrs of the Modern Zeal; Volumes of Poetry, Shadows, _______________ and Rivers"[3]; all things that either won't burn or should burn. He also sold worthless life insurance for criminals in the form of a meaningless pardon, an allusion to absolution.[4] Another of Peter's speculative ventures was in the field of entertainment. He was "also held the Original Author of Puppets and Raree-Shows . . ."[5]

These projects had nothing to do with science--they were simply easy ways to make money. But Peter was also a virtuoso-projector. He made several scientific "discoveries" which he turned into products to sell the public. He manufacutured remedies for worms in the spleen (a reference to penance) and opened a "Whispering-Office" to cure those who were "Hypochondriacal, or troubled with the Cholick,"[6] (an allusion to confession). He also discovered a new universal pickling process which, though it appeared to be exactly like other pickling solutions, had wonderful powers. "The Patient who was to be pickled, if it were a House, would infallibly be preserved from all Spiders, Rats and Weazels . . . It also infallibly took away all Scabs and Lice, and scall'd Heads from Children . . ."[7] So Swift satirizes the Catholic use of Holy Water.

Swift notes four types of projectors, all represented by Peter. There are those who deal in foreign trade, those who sell insurance, those who manufacture and sell merchandise, and those who speculate on entertainment ventures. The developing character of the projector is apparent in the traits these four have in common. Each is dependent upon public support, and, more important, each is a cheat or a trickster. The land cannot be reached, the insurance is worthless, the products are mostly quack remedies, and the entertainment is childish and trivial.

Numerous projectors appear in The Spectator also. Several of them correspond to types mentioned by Swift. In Spectator No. 31, April 5, 1711, Addison describes a projector he meets in a coffee-house.

> Last Night, upon my going into a Coffee-House not far from the Hay-Market Theatre, I diverted my self for above half an Hour with overhearing the Discourse of one, who, by the Shabbiness of his Dress, the Extravagance of his Conceptions, and the Hurry of his Speech, I discovered to be of that Species who are generally distinguished by the Title of Projectors. This Gentleman, for I found he was treated as such by his Audience, was entertaining a whole Table of Listners with the Project of an Opera, which he told us had not cost him above two or three Mornings in the Contrivance, and which he was ready to put in Execution, provided he might find his Account in it. He said, that he had observed the great Trouble and Inconvenience which Ladies were at, in travelling up and down to the several Shows that are exhibited in different Quarters of the Town. The dancing Monkies are in one Place; the Puppet Show in another; the Opera in a third; not to mention the Lions, that are almost a whole Day's Journey from the Politer Part of the Town. . . . In order to remedy this great Inconvenience, our Projector drew out of his Pocket the Scheme of an Opera, Entitled, The Expedition of Alexander the Great; in which he had disposed all the remarkable Shows about Town, among the Scenes and Decorations of his Piece.[8]

The projector continues to describe a show which would contain a veritable mishmash of unrelated and misproportioned spectacles.

Like Swift, Addison was satirizing the speculator. From his description, one sees several characteristics of the projector. Like the virtuosos described in the last chapter, this man suffers from the "Extravagance of his conceptions." His dreams are too large and his thoughts too small. The result of the distinction between his ambitions and his abilities is that he continually fails to achieve any goal at all, hence the "shabbiness of his dress."

Not all projectors appearing in the Spectator are poor, however. Like the virtuoso, the projector often mistakes merely a new idea for a good one. Unfortunately, the gullible public often follows his example. In Spectator No. 452, August 8, 1712, a project is described that satirizes both the speculator and men who are so obsessed by a desire to hear news that they will purchase even worthless newspapers. The projector's idea is to print a daily paper filled with news from the villages around London, delivered to him by post from various correspondents. Some of the items he proposes to print, for example, are "that a Horse was clapped into the Pound [at Knightsbridge]," "that a certain Person well known in [Putney] is like to lose his Election for Church-warden," and "that things remained [in Fulham] in the same State they were."[9] This projector, like

Peter in Swift's Tale of a Tub, uses the weaknesses of other men to strengthen his own coffers. A few days later the same character writes to suggest another project,

> 'I have often thought that a News-Letter of Whispers, written every Post, and sent about the Kingdom . . . might be highly gratifying to the Publick, as well as beneficial to the Author. By Whispers I mean those Pieces of News which are communicated as Secrets, and which bring double Pleasure to the Hearer; first, as they are private History, and in the next place, as they have always in them a Dash of Scandal.[10]

So the projector capitalizes on mens' desires to know the secrets of others. The financial success of his ventures is emphasized in the first paragraph of his letter, when he tells the Spectator, "you must know, Sir, that we . . . cannot think any Scheme practicable or rational before you have approved of it, tho' all the Mony we raise by it is on our own Funds, and for our private Use."[11]

Addison also gives an example of the virtuoso-projector, a man who invents a machine to write Latin verses. In order to distinguish the inventor from other types of projectors, Addison refers to him by both titles, as Swift had done.

> But of all Contractions or Expedients for Wit, I admire that of an ingenious Projector whose Book I have seen: This Virtuoso being a Mathematician, has, according to his Taste, thrown the Art of Poetry into a short Problem, and contriv'd Tables by which any one, without knowing a Word of Grammar or Sense, may, to his great Comfort, be able to compose or rather to erect Latin Verses. . . . What a Joy must it be to the unlearned Operator, to find that these Words, being carefully collected and writ down in order according to the Problem, start of themselves into Hexameter and Pentameter Verses? A Friend of mine, who is a Student in Astrology,

> meeting with this Book, perform'd the Operation by the Rules there set down; he shew'd his Verses to the next of his Acquaintance, who happened to understand Latin; and being informed they described a Tempest of Wind, very luckily prefix'd them, together with a Translation, to an Almanack he was just then printing, and was supposed to have foretold the last great Storm.[12]

This scientist has indeed invented a new machine, but it is virtually useless. Just as one does not need fire insurance for a river, so one who does not read Latin does not need a machine to build him Latin verses. The machine profits another trickster, the astrologist, quite by accident. Addison's essay illustrates another characteristic often associated with the projector, also. Trying to do something new, he destroys the old beauty or usefulness of the materials he works with. Writing poetry is supposed to be a creative process, but in the hands of the projector it becomes a mechanical one.

Each of these three characters corresponds in some way to the projector in *A Tale of a Tub*. In several *Spectator* papers, however, Addison mentions another kind of speculator--a political projector. This man wishes to fill a useless government position and thus, like the other speculators, receive something of worth (usually money) for his worthless activity. In *Spectator* No. 28, April 2, 1711, Addison prints a letter from a projector who wants to create and fill an office for inspecting sign-posts. Addison uses the paper, he says, to satirize "Projectors in general" and "the whole Art of Modern Criticism."[13] A similar figure appears in No. 251, December 18, 1711. This man wishes to be appointed "Comptroller general of the London Cries." The primary concern of this political projector is to find a profitable employment for himself, though he pretends to be public-spirited. He begins his letter:

> I am a Man out of all Business, and would willingly turn my Head to any thing for an honest Livelihood. I have invented several Projects for raising many Millions of Mony without burthening the Subject, but I cannot get the Parliament to listen to me, who look upon me, forsooth, as a Crack and a Projector; so that despairing to enrich either my self or my Country by this Publick-spiritedness, I would make some Proposals to you relating to a Design, which I have very much at Heart, and which may procure me an handsom Subsistance, if you will be pleased to recommend it to the Cities of London and Westminster.[14]

In the early eighteenth century, then, Swift and Addison used the term projector to refer to various sorts of speculators. The word was sometimes associated with the businessman who tried to sell a worthless product, sometimes with the scientist who invented a quack remedy or a worthless device, and sometimes with the politician who wished to fill a worthless office. Addison summarizes his feelings about the failings of all these men in Spectator No. 535, November 13, 1712. Writing about the necessity of rationally controlling one's hopes, Addison says,

> Many of the Miseries and Misfortunes of Life proceed from our want of Consideration, in one or all of these Particulars. They are the Rocks on which the sanguine Tribe of Lovers daily split, and on which the Bankrupt, the Politician, the Alchymist and Projector are cast away in every Age. Men of warm Imaginations and towering Thoughts are apt to overlook the Goods of Fortune which are near them, for something that glitters in the Sight

> at a distance; to neglect solid and substantial Happiness, for what is showy and superficial; and to condemn that Good which lies within their reach, for that which they are not capable of attaining. Hope calculates its Schemes for a long and durable Life; presses forward to imaginary Points of Bliss; and grasps at Impossibilities: and consequently very often ensnares Men into Beggary, Ruine and Dishonour.[15]

The projector, then, like the virtuoso, was involved in impossible dreams. When these dreams led only to his own ruin, he could be labeled the fool and pitied. But all too often the projector combined the foolish notions of the virtuoso or alchemist with the politician's power to manipulate the public and the businessman's power to extract money from the public. The projector who had gained these powers was dangerous as well as foolish.

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Just as the virtuoso figure reflected some of the real difficulties which early Royal Society members had to overcome, so the projector had his historical counterpart. The early eighteenth century was a period of rapid increase in industry and commerce in England. There were new trading companies, insurance companies, and manufacturers looking for people who would invest money in their ventures. Some were successful; others were obvious cheats. In London in 1720, the year the South Sea Bubble burst, stock in speculative companies was being bought and sold in every coffeehouse. Virginia Cowles, in _The Great Swindle: The Story of the South Sea Bubble_, offers examples of a few of the many companies selling stock in London at that time.

Besides the famous East India Company and the infamous South Sea Company, there were numerous other enterprises for establishing trade routes. Virginia Cowles quotes several advertisements from the Daily Post which illustrate this.

> Whereas permits were delivered out yesterday at the Salutation Tavern in Nicholas Lane in Lombard Street for shares in a sum of 1,000,000 l. sterling for effectually carrying out the African trade. Such permits will this day continue to be deliver'd out in the said trade at 2s. 6d. each share . . .
>
> Pursuant to Notice given in this paper of Wednesday the 20th Instant this is to acquaint all persons concern'd in the Subscription toward carrying on a Trade to the Bay of Cappeachy that the Banker's man will attend at the Virginia Coffee House . . .
>
> Whereas it was advertis'd yesterday in the paper that a meeting of the subscribers to the Barbary & African Trade was to be this day at the Ship & Castle Tavern in Cornhill it is for very good reasons deferr'd . . .[16]

Numerous insurance companies were founded also: "for insuring all masters and mistresses the losses they may sustain by servants," "for insuring marriage against divorce," "for insuring all sorts of Goods and Effects from Theft and Robberies, both by Sea and Land," and "for the furnishing of funerals to any part of Great Britain," to name a few.[17]

And, there were companies formed to manufacture new products. There were schemes to extract silver from lead, to turn mercury into a solid like silver, to make salt water fresh, to breed silkworms in Chelsea Park, to manufacture wheels of perpetual motion, and to make oil from sunflower seeds, for example.[18]

The projectors that Swift and Addison mention, then, were part of the London commercial scene in the first quarter of the eighteenth century. At least a few of these schemes were justifiably associated with the scientist. Bacon had promised that science could produce new products and increase prosperity. It seemed that, in order to keep this promise, science would have to join forces with industry and commerce.

The early satirists were also justified in associating the projector with the politician. The association of a powerful political figure with a company gave it an air of credibility which helped the speculator gain public subscriptions. The Governor of the South Sea Company, for example, was George I. Furthermore, Robert Harley's attempts to use this speculative company to remove England's national debt--a political and economic problem--resulted in the unfortunate collapse of the "South Sea Bubble." Other political figures were involved in other companies. The Prince of Wales was a Governor of the Welsh Copper Company. The Duke of Bridgewater and the Duke of Chandos both invested in building companies.[19] So, business interests and political interests were beginning to merge. Politicians were invading the world of business and, slowly, the economic ground of the country was shifting from the hands of the landowner to the hands of the industrialist.

To confuse the issue still further, during this period scientists were again gaining some political power and politicians were becoming involved with science. This movement began, I think, in the 1680's, after Charles II died. The Royal Society, as I mentioned above, was experiencing a period of decline. I feel the members of the society attempted to regain the political support they lost at Charles's death by electing presidents who had political rather than scientific influence.

In 1685 Samuel Pepys was president of the Royal Society. When elected in 1684, he had just lost his position in the navy administration. In 1686, when he was appointed Secretary of the Admiralty, he resigned the presidency.[20] Pepys, then, served the Royal Society during a period when he was politically inactive. But the contrary is true of the presidents who followed him. John Vaughn, who was president from 1686 to 1689, was elected president the same year he became third Earl of Carbery. Most of the presidents before him had been original fellows of the society; Vaughan had been made a member in 1685, one year before he was elected president.[21] Thomas Herbert, the Earl of Pembroke, followed Vaughan and was president for one year, 1689-90. In 1689 he had carried the sword of justice in the coronation of William and Mary and had been named Lord-Lieutenant of Wilshire at that time. In the year he was president he is said to have never presided at a Royal Society meeting.[22]

Neither Vaughan nor Herbert proved an effective leader for the society, but the members continued electing men with political power. In 1690 they chose Sir Robert Southwell, the newly appointed Secretary of State for Ireland.[23] In 1695, one year after he had been named Chancellor of the Exchequer, Charles Montague was made president.[24] And, in 1698, a year after he became Lord Chancellor, John Somers, another powerful Whig leader, became president of the Royal Society.[25] Here, then, were five consecutive presidents who were elected within a year of the time they received important political appointments. With the exception of Southwell, who became a fellow in 1663, they were not men who were long-standing, devoted society members. Montague, in fact, became a fellow the same day he was elected president, and the same was true for Somers.[26] Though Southwell had published one paper in the Philosophical Transactions, none of these men was a scientist. Their political strength, however, did seem to strengthen the society. By 1705 the number of members had risen from its low mark of 115 in 1687 to 131, and the Philosophical Transactions were again being published regularly.[27]

While the Royal Society was trying to find political allies, several scientists were becoming involved in political affairs. Edmund Halley was successfully getting government money to carry on his scientific work, and

Isaac Newton, after completing most of his scientific studies, had moved to London and was concerning himself with political issues. Once again we see politics influencing science and scientists becoming political, a merging of these two worlds.

Edmund Halley was quite successful at securing government support for his scientific projects. In 1676, while he was still a student at Oxford, he received help from Charles II which enabled him to travel to the Island of St. Helena in the East Indies and catalogue the positions of the stars of the Southern Hemisphere. In 1698 he received a grant from King William which allowed him to take a voyage to study the variation of the compass. In 1721, after completing several other Royal projects, he was appointed Astronomer Royal. Halley's work carried with it hopes of great practical application for a nation dependent on navigation. On his first voyage, he catalogued the positions of 350 stars. He hoped that his study of the compass would lead to the discovery of an easy way to determine longitude at sea.[28] His interest in longitude prompted him to study the moon, for he knew that if men could determine the exact position of the moon for a particular time, they could figure longitude. His study of the moon led him to Isaac Newton, and it was, in fact, at Halley's insistence and with his financial help that Newton published the <u>Principia</u> in 1687.[29]

Newton first became politically involved right after the Principia was published. In 1687 he represented the senate of the University of Cambridge in a quarrel between the university and James II. In February 1687, James, who was constantly involving England in religious controversies, ordered that a Benedictine monk be granted a Master of Arts degree without taking the customary oaths. The university had established the oaths as a restriction against Catholics and had waived them only on those occasions when hononary degrees were to be granted to foreigners. Holders of honorary degrees could not vote in the university senate; persons with regularly conferred degrees could. The university senate, fearing that James intended to control the university by forcing it to grant degrees to Catholics until they held a majority vote, refused to confer the degree. On April 9, 1687, the Vice-Chancellor of the university and representatives of the senate, of which Newton was one, were summoned to appear before the High Court of Commissions. Even though all the other delegates felt they should meet the demands of the King, Newton refused to compromise and was able to convince the others to follow his example. The university officials were released with a warning that their cooperation would be expected in the future, but James did not press them further.[30]

This incident began Newton's interest in politics. In 1688 he represented Cambridge at the Parliament that invited William and Mary to rule England. While in London he became acquainted with the Whig leaders, John Somers and Charles Montague, whom he had previously known at Cambridge. He also became close friends with John Locke, who introduced him to other powerful people.[31] In February 1689/90 the Whigs fell from power and Newton had to return to Cambridge. He soon began to urge his friends to secure a government position for him, and in March 1695/96, with the help of Somers and Montague, Newton became Warden of the Mint.[32] The scientist was involved in politics and, as the administrator of the mint, he was becoming involved in economics as well.

In 1692 Montague had been appointed Lord of the Treasury and in 1694, Chancellor of the Exchequer. He determined that he must stop the depreciation of English currency and convinced Parliament to accept a proposal that would change the economic structure of the country. Montague wanted to call in all the English coins and remint them. This tremendous task was accomplished during the years that Newton managed the mint, from 1696 to 1699. Under Newton's supervision, as many as eight times as great a weight in coins was produced per week than ever had been before.[33] The recoining operation stabilized the economy, but it also established the national debt and, indirectly, led to the South Sea Bubble. In order to recoin the money, Montague had to get £1,200,000. He suggested that a private bank be founded whose shareholders would agree to lend the government money at 8% interest. So, the Bank of England was founded. The bank was controlled by Whig landowners, and, as a result, even when the Tories had political control of the country, economic control remained with the Whigs. In 1711, the Tories tried to regain economic control of the country through the South Sea scheme. The South Sea Company agreed to take over the national debt. By August, 1720, the price of South Sea stock had soared to 900. When, in the next month, it fell to 190, many people were ruined.[34] Newton, of course, had nothing to do with the South Sea Company. As a Whig and a friend of Montague, he was only involved with the economic policies which led to the founding of the Bank of England. When the new money had been coined, Newton was promoted to Master of the Mint, an administrative position which required him to work one or two days a week. He held this position for the rest of his life.[35]

During the years that followed, Newton's reputation as a scientist grew. In 1703 he was elected president of the Royal Society, another position he held until he died. Under the leadership of a man who had both political influence and scientific prestige, the society prospered. By 1710 Newton was becoming a public symbol for the great scientist. He was referred to in The Tatler as "the greatest mathematician and philosopher that ever lived,"[36] and in Spectator papers as "the Miracle of the present Age," and "the Glory of our own Nation."[37] In 1705 he was knighted by Queen Anne, and, according to Weld, when George I came to the throne Newton became "an object of interest at Court, and was honoured by the friendship of the Princess of Wales."[38]

During the early eighteenth century, then, the scientists appeared to be involving themselves more and more in other areas of life. Newton, the greatest scientist of the age, held a political position, had powerful Whig friends, was accepted at Court, and had helped restructure the economic system of the country. Other men were using scientific ideas and the promise of scientific accomplishments to begin speculative companies or to get government support for their projects. In this setting the virtuoso character lost much of his meaning. One could not satirize an Isaac Newton or an Edmund Halley by putting him in a domestic setting and letting him pursue useless ideas. The virtuoso was a powerless character and could not be successfully used to represent men with power. The virtuoso was a man who was involved only in science, also, and did not represent completely those scientists who were involved in the affairs of the world. The projector, however, because he could represent the politician and the speculator as well as the scientist and because he had the power to involve other people in his ruin, could represent the scientist of this time; and, for Jonathan Swift, he did.

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In Gulliver's Travels, Swift shows the limitations of man, but he also shows the limitation of those things men count on to help them overcome their weaknesses and create a better world.[39] In the "Voyage to Laputa, Balnibarbi, Glubbdubdrib, Luggnagg, and Japan," Swift shows a science that does not improve human life, even when it is backed by political power. Once again, it is helpful to remember that, from the time of Bacon, the new scientists had promised that their discoveries would lead to a greater appreciation of God and to practical benefits for man. In the "Voyage to Laputa," Swift shows that science does not help men with either of these. Furthermore, he shows the danger of mixing either the abstract or the practical sciences with politics. The scientist who must depend on his own power is simply foolish, but the scientist with political power is both foolish and dangerous.

When he is taken up into the flying island of Laputa, Gulliver becomes part of a strange and rather disconcerting world. In it, the overwhelming presence of the abstract sciences has destroyed the natural order of things by removing the minds of the people from the real world below, allowing them, in fact encouraging them, to "fly off" on tangents of abstract speculation. Their feet rest, not on the ground, but on a base of scientific theory which they fear contact with the real world might break.

The abstract scientists on Laputa are pictured as men whose speculation yields nothing of practical value. Their houses are poorly constructed because their mathematical calculations are too complex for the workmen to follow. The clothes the tailor makes for Gulliver do not fit because he insists on taking measurements with a quadrant and compass instead of in the usual, simpler way. The Laputans have attempted to do everything in the most scientific way, but rather than improving the world, their method seems to be making it worse.

Their sciences do not lead them to a better understanding of the deity, either. Rather, their knowledge creates in their society new fears--fears that the sun will go out, that the earth will be absorbed by the sun, that a comet will hit the earth and burn it up. Rather than helping men feel at peace with God, scientific speculation causes the inhabitants of Laputa to be "under continual Disquietudes, never enjoying a Minute's Peace of Mind."[40]

Just as their knowledge causes fear of the universe rather than security in it, so their attempts to use their knowledge to demonstrate the harmony of the universe are useless. The Laputans attempt to accompany the "Music of the Spheres" on their earthly instruments. Gulliver reports that he was "quite stunned with the Noise."[41] The scientists in the eighteenth century felt that they could draw men closer to God by pointing out the wonders of his creations. Gulliver discovers, however, that it is useless to try to blend earthly instruments with the heavenly harmony. If the scientists could indeed hear the music of the spheres, they were not able to communicate its beauty to common men. The scientists' attempts to help men understand the heavens, again, fail.

The abstract philosophers of Laputa, who accomplish neither of the goals of the scientist, seem ridiculous, as earlier virtuoso characters did. But because of their political connections, they are also potentially dangerous. The King, living in a court of philosophers, has had his natural curiosity perverted. He is not interested in learning those things which might help him rule his kingdom--he asks Gulliver no questions concerning "the Laws, Government, History, Religion, or Manners" of other countries.[42] He is interested only in mathematics.

The same is not true, however, for the mathematicians, who are continually stepping outside their realm of knowledge and interesting themselves in news and politics. As Gulliver observes,

> But, what I chiefly admired, and thought altogether unaccountable, was the strong Disposition I observed in them towards News and Politicks; perpetually enquiring into publick Affairs, giving their Judgments in Matters of State; and passionately disputing every Inch of a Party Opinion. I have indeed observed the same Disposition among most of the Mathematicians I have known in Europe; although I could never discover the least Analogy between the two Sciences; unless those People

> suppose, that because the smallest Circle hath as many Degrees as the largest, therefore the Regulation and Management of the World require no more Abilities than the handling and turning of a Globe. But, I rather take this Quality to spring from a very common Infirmity of human Nature, inclining us to be more curious and conceited in Matters where we have least Concern, and for which we are least adapted either by Study or Nature.[43]

Swift shows throughout the section concerning the flying island that the mixture of abstract science and politics creates a most unreasonable world. The confusion results from the fact that those men who have developed their scientific senses have lost the use of the "common" senses. Bacon had said that science would progress when men developed aids for their senses which would help them observe nature more accurately. The Laputans have successfully done this. With their improved telescopes they have been able to catalogue ten thousand stars, discover two moons of Mars, and chart the paths of ninety-three comets. But the philosophers themselves cannot see correctly. They can observe the heavens, for one eye of each philosopher is pointed upward; they can observe their own minds, for one eye of each philosopher is pointed inward; but they are incapable of seeing the world around them. Without servants to protect them they are in constant danger of running into posts and dashing their brains out. Their sense of hearing is also impaired. They can hear the music of the spheres, but to hear other men they must be roused by their flappers.

The philosopher who almost undoubtedly served as a model for the Laputans was Sir Isaac Newton. Arthur E. Case has suggested that the flying island symbolizes the Court of George I, and Newton, as was mentioned above, frequented the Court. Newton, as Master of the Mint, had played a small part in the controversy over Wood's copper coins, thought to be allegorized by the Lindalino rebellion in the "Voyage to Laputa."[44] And, of course, Swift and Newton were dedicated to different political parties. However, I believe that Swift chose Newton as a model not from a spirit of political vindictiveness but because Newton was being acclaimed as England's greatest scientist. If even the greatest of scientists is foolish, then science itself can hardly be an answer to the problems of the world, Swift seems to be saying.

There are several similarities between Newton and the Laputans. Most obvious, the sciences Swift chose to attack were mathematics and astronomy, both closely associated with Newton's work. One of Newton's biographers has suggested that the flappers on Laputa were intended to be a direct satirical attack on Newton, for, like the Laputans, Newton tended to be absent-minded.[45] Other scholars feel that the problems the Laputans had with their calculations was a direct reference to Newton, whose work had been halted several times because of mathematical difficulties. His early work on the theory of gravitation was hampered because he was using an incorrect calculation for the measurement of the earth. Later, a printing error which appeared in one of his publications made his calculation of the distance from the sun to the earth seem ridiculously incorrect.[46]

More interesting are some of the more subtle associations between Newton and the Laputans Swift might have been drawing. The intent of the Principia was to show that the same laws govern the movement in the heavens as govern earthly motion. Hence, there is a sameness or harmony between the laws of the heavens and the earth. So, the horribly discordant Laputan symphony may have been a veiled attack on Newton's most famous theory.

Newton was also involved in astronomical work, as were the scientists on Laputa. The reference to the "catalogue of ten thousand fixed stars" might have been intended to remind the reader of an unpleasant controversy between Newton and John Flamsteed, who had been trying to publish a complete catalogue of the fixed stars. Newton had used his political power to try to force Flamsteed to publish his catalogue before he had finished his work. When Flamsteed protested, Newton appointed Edmund Halley, Flamsteed's great rival and Newton's close friend, to take Flamsteed's calculations and prepare a catalogue for publication. When the work was published in 1712, it was incomplete and inaccurate. Flamsteed, who was justifiably upset and embarrassed, gathered up all the copies he could obtain and burned them. He then continued his own work until he died in 1719.

The complete Historia Coelestis Britannica, finished by his assistant, appeared in 1726.[47]

Finally, like the scientists on Laputa, Newton had fears concerning the way the world would end. His assistant at the mint and one of his closest friends, John Conduitt, recorded a conversation he had with Newton in March 1724/25. During a discussion concerning the heavenly bodies, Newton suggested that they were subject to decay and replenishment. "Vapours" in the heavens, he said,

> . . . gathered themselves by degrees into body, and attracted more matter from the planets; and at last made a secondary planet [a moon], and then by gathering to them and attracting more matter, became a primary planet; and then by increasing still, became a comet, which after certain revolutions, by coming nearer and nearer to the sun, had all its volatile parts condensed, and became a matter fit to recruit, and replenish the sun, which must waste by the constant heat and light it emitted.[48]

Newton went on to suggest that the 1680 comet, after five or six revolutions, would drop into the sun and thus increase the heat of the sun so much that the earth would be completely burned. Though these fears are not exactly those of the Laputans, they are similar, and the result, the total destruction of the earth, is the same. Whether Swift knew that Newton held these beliefs is almost impossible to tell. Newton's conversation with Conduitt does, however, substantiate Marjorie Hope Nicolson's argument that Newton's philosophy lies behind many of the Laputans' fears.[49] Again, the new philosophy, and specifically Newton's great Principia, fails to encourage religious belief and instead sparks needless anxieties.

By 1727 Newton had become a figure for the outstanding British scientist. But, Swift says, if one considers that even the "miracle of the age" is absent-minded, befuddled by mistakes, unfair to his colleagues, and beset with false fears, one realizes that the abstract sciences are not able to save men from littleness and foolishness. A land run by scientists can be no better, and will probably be worse, than a land in the hands of more normal politicians.

Gulliver is not fooled by the philosophers on Laputa. Though their perception has been damaged by their interest in science, his perception remains clear. Feeling that he "never met with such disagreeable Companions," he gets permission to visit Balnibarbi, the land below. On his visit, Gulliver is introduced to the practical philosopher, the projector, another character who dangerously mixes science with politics.

In his essay on "Personal and Political Satire in Gulliver's Travels," Arthur E. Case suggests that the Academy of Projectors is intended to satirize the speculative craze which caused financial chaos in England in 1720.[50] Marjorie Hope Nicolson, in "The Scientific Background of Swift's Voyage to Laputa," has traced the scientific sources for the experiments done in the academy.[51] Both seem to be important parts of the satire. Swift selected experiments that would be associated with the Royal Society and mixed them with popular financial schemes in order to show how much the two had in common. When the experimenter lives in a society which encourages scientific speculation, Swift shows, the result will not be progress, as the Baconian philosophy promised, but, again, chaos. For while the experimenters in the academy were trying unsuccessfully to get their experiments to work, the country lay in waste around them. The projectors, like those who came before them, are fascinated by anything that is new. They determine to overhaul arts, sciences, mechanics, agriculture, building, politics--in short, everything in the country--quite sure that the new will be better than the old. But their experiments produce nothing--they do not have the creative power to change the world, only the political power needed to destroy the old foundations. As a result, Gulliver finds Balnibarbi a country in ruins.

When Gulliver arrives in the country, he sees immediately that this system is wrong and that the old way, represented by Munodi's prosperous estate, is better. During his visit to the Academy of Projectors, however, Gulliver's sense of values becomes confused, and he loses his ability to perceive good and bad.

Gulliver begins his tour in the scientific section of the academy. Most of the experiments he sees there are parodies of actual experiments performed by members of the Royal Society.[52] The important point, however, is that the experiments warp Gulliver's view of nature. They show Gulliver a nature that is, at best, backwards, at worst, ugly and perverted. In Balnibarbi, science does not help people perceive more clearly, nor does it leave them any better off than they were before. Instead, it actually makes them perceive nature more incorrectly than they had before. In the hands of the projector, natural order loses its meaning. Instead of food being turned to human excrement, Gulliver is told that human excrement will be turned into food. Instead of sunshine causing the growth of cucumbers, cucumbers are supposed to yield sunshine. Instead of fire and ice being opposite things, they are treated as though they were the same. Houses, instead of being built from bottom to top, as they always have been, are built from top to bottom. Furthermore, in the hands of the projector, beauty as well as order is removed from nature. When a blind man can distinguish colors, the whole concept of color has lost its meaning and its beauty. Making sheep naked is not only impractical but also makes the sheep ugly. The projector's experiment with the bellows and the dog kills the dog, but it is also extremely offensive. Gulliver looks at nature and sees that those parts of nature he valued--its order and its beauty--are not of value to the practical-minded projectors.

Gulliver is next taken to the academy for the speculative sciences, and there he is shown a new view of language. In the hands of the projector, language loses its artistic value and becomes something purely mechanical, as it had when Addison's projector made the machine that wrote Latin verses. A book is no longer a communication between men, because it is written by a mindless machine and means nothing. Instead of language symbolizing objects, Gulliver sees the projectors try to use objects to symbolize language. So language, along with nature, loses its meaning for Gulliver because it has been twisted and perverted by the projector.

By the time he reaches the school for political projectors, Gulliver's system of values has become so confused that he can no longer tell good from bad. Those things men use to preserve a system of values, trust in the order and beauty of nature and of language, have been changed for Gulliver. So he says of the political projectors,

> In the School of political Projectors I was but ill entertained; the Professors appearing in my Judgment wholly out of their Senses; which is a Scene that never fails to make me melancholy. These unhappy People were proposing Schemes for persuading Monarchs to chuse Favourites upon the Score of their Wisdom, Capacity and Virtue; of teaching Ministers to consult the publick Good; of rewarding Merit, great Abilities, and eminent Services; of instructing Princes to know their true Interest, by placing it on the same Foundation with that of their People: Of chusing for Employments Persons qualified to exercise them; with many other wild impossible Chimaeras, that never entered before into the Heart of Man to conceive; and confirmed in me the old Observation, that there is nothing so extravagant and irrational which some Philosophers have not maintained for Truth.[53]

During his tour of the academy of projectors, Gulliver has been changed. When he began, he knew right from wrong, good from bad. But, like the projector's, Gulliver's system of values has been confused by the new science. By the time he finishes his tour, good ideas look foolish to him.

The members of the Academy of Projectors are able to ruin Balnibarbi because they have gained political power. Munodi tells Gulliver

> That about Forty Years ago, certain Persons went up to Laputa, either upon Business or Diversion; and after five Months Continuance, came back with a very little Smattering in Mathematicks, but full of Volatile Spirits acquired in that Airy Region. That these Persons upon their Return, began to dislike the Management of every Thing below; and fell into Schemes of putting all Arts, Sciences, Languages, and Mechanicks upon a new Foot. To this End they procured a Royal Patent for erecting an Academy of Projectors in Lagado: And the Humour prevailed so strongly among the People, that there is not a Town of any Consequence in the Kingdom without such an Academy.[54]

Their travel to Laputa gave them a love for political power and philosophical dreams. They failed to acquire, however, either the moral power or the power to improve which advocates of science claimed a study of the field could bring. Instead, their science destroys moral perception and wrecks the prosperity the people of the country previously enjoyed. To make matters worse, the more completely they fail, the harder they continue to try, driving the country to further ruin, for "instead of being discouraged, they are Fifty Times more violently bent upon prosecuting their Schemes, driven equally on by Hope and Despair."[55]

When the scientist gains power, Swift shows, he becomes able to affect the lives of those around him, and he must be willing to accept responsibility for his actions. The scientists in Laputa and Balnibarbi are not being intentionally evil. They are seriously trying to improve the world. But they are failing, and, whatever their intentions, they should accept responsibility for the ruin around them. Their moral obligation for the destruction they cause, however, is significantly different from Frankenstein's. They are not able to create anything dangerous, because they have no power to create. They are not, then, responsible for their achievements, but only for their failures.

Though Swift's philosophers and projectors are uglier than the virtuosos were, they are still satirical characters and essentially humorous. And, though they have gained political power, they are still grasping for the power Bacon envisioned when he said, "knowledge and human power are synonymous."

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Another interesting view of the dangers of mixing science and politics appeared in A Voyage to Cacklogallinia, published in 1727,[56] only one year after Gulliver's Travels. The pretended author of the work (the identity of the real author is unknown) was Captain Samuel Brunt, an adventurer who, like Gulliver, visits a strange land inhabited by human-like animals--in this case, giant chickens. The abuses in the chicken society closely parallel those of the English court during the South Sea Bubble years. Brunt describes a land where the good are destitute and the wicked prosper. The most powerful members of the court are the Squabbaws, the king's mistresses. Those who can ingratiate themselves with the king or the Squabbaws gain power; those foolish enough to believe that merit should be rewarded are doomed to failure.

The scientist figure appears in the last third of the book, the part which openly satirizes the South Sea Bubble. After he has become fully acquainted with the Cacklogallinian way of life, Samuel Brunt is recruited to help the government raise money to pay its war debts. He is named "project examiner," a position which requires him to consider various moneymaking proposals and determine which ones the government should try. After rejecting suggestions for numerous new taxes--a tax on coaches (rejected because it would hurt the rich) and a tax on sunlight or spring water (seriously considered because it would burden only the poor)--Brunt was presented with an elaborate "Project for fetching Gold from the Moon." Though Brunt rejected the scheme as being impractical, the greedy politicians accepted it, and thus the scientist, who is to plan and execute the expedition, is introduced.

The scientist in Cacklogallinia is a strangely ambiguous character. As a projector, he is at least partly to blame for the eventual failure of the expedition to bring back gold. It is he who has theorized that there will be an abundance of every sort of metal on the moon. He is denied the chance, however, to verify his theory. When he arrives on the moon, he finds that the Selenites are not interested in wealth and will not cooperate with the project. So, the one theory that might be "useful" to men is not proved. The scientist is able to prove all of his more philosophical theories, however. Before the voyage, he makes numerous suggestions--that the moon is an earth like our earth; that a being outside the gravitational pull of the earth will not fall, will move at incredible speeds, and will not hunger and thirst; that an animal body can accustom itself to breathing the rarified air of space--which, within the fictional context of the work, are all proved to be correct.[57] The scientist is, then, successful in many ways. He does discover new knowledge, though it is not knowledge that the morally weak Cacklogallinians are able to care about because it brings no profit.

The Scientist really seems more interested in his philosophy than in the practical implications of his work. Apparently, the only way he could hope to receive government support for his project was to stress its potential profit. After the journey toward the moon starts, however, he seems totally uninterested in the "project" part of the venture.

He thus becomes an easy tool for the politicians, who distort the reports of the expedition's progress in order to manipulate the price of the stock and assure themselves fantastic profits. Because he is engrossed in his scientific work, the philosopher never questions the ethics of his role in a scheme that drives many innocent people to financial ruin. The politician is obviously at fault for using science for his own unworthy ends. But the scientist is guilty of being so concerned with science that he disregards the social problem that results from his work.

Though Cacklogallinian science is useless, its philosophical implications are profound. When the scientist and Samuel Brunt, who has accompanied him on his voyage, reach the moon, they discover something which, we are led to believe, is more important than a mountain of gold. They discover the wonder of God, reflected in his creation. The narrator, having arrived on the moon, says:

> I found my Spirits so invigorated by the refreshing Odours, of this Paradice, so elated with the Serenity of the Heavens, and the Beauties which every where entertained and rejoiced my Sight, that in Extasy I broke out into this grateful Soliloquy. *O Source of Wisdom, Eternal Light of the Universe! What Adorations can express the grateful Acknowledgments of thy diffusive Bounty! Who can contemplate the Beauty of thy Works, the Product of thy single Fiat, and not acknowledge thy Omnipotence, Omniscience, and extensive Goodness! What Tongue can refrain from singing thy Praise! What Heart so hard, but must be melted into Love! Oh Eternal Creator, pity my Weakness, and since I cannot speak a Gratitude adequate to thy Mercies, accept the Fulness of my Heart, too redundant for Expression.*[58]

Though science does not succeed in benefiting men financially, it does bring them closer to God. As a result, Brunt and the scientist become more worshipful. The passage continues,

> As I spoke this, in the Cacklogallinian Tongue, Volatilio came up to me, and said, "Alas! Probusomo, how can a finite Being return Praises adequate to infinite Mercies! Let us return such as we are capable of; let the Probity of our Lives speak our Gratitude; by our Charity for each other endeavour to imitate the Divine Goodness, and speak our Love to him, by that we shew to Mortals, the Work of his Divine Will, however they may differ from us, and from one another, in their Species.[59]

During his stay on the moon, Samuel Brunt's moral education is completed. He discovers that souls, in a state between life and death, dwell on the moon. These virtuous beings teach him to distinguish good from evil.

At the beginning of the book, Samuel Brunt is totally naive. He describes English society to the Cacklogallinians as a political utopia full of virtuous noblemen.

> My Lord, said I, our great Men are the brightest Examples of Piety. Their Veracity is such that they would not for an Empire falsify their Word once given. Their Justice won't suffer a Creditor to go from their Gate unsatisfied: Their Chastity makes them look on Adultery and Furnication /sic/ as the most abominable Crimes; and even the naming of them will make their Bloods run cold. They exhaust their Revenues in Acts of Charity, and every great Man among us is a Husband and Father to the Widow and Orphan. . . . At Court, as I have learn'd, there is neither Envy nor Detraction, no one undermines another, nor intercepts the Prince's Bounty or Favour by slandrous Reports; and neither Interest, Riches, nor Quality, but Merit only recommends the Candidate to a Post . . . [60]

This is an idealistic picture of the English Court, at best.

The narrator's moral education begins when he arrives at Cacklogallinia. As the protégé of the prime minister, he becomes familiar with the ways of the Cacklogallinian Court, which is full of power-hungry chickens who maintain peace and stability only through mutual hate and distrust. Though Brunt is able to maintain some of his innocent virtues, he soon begins to think like the Cacklogallinians. When he is approached by an army officer, for example, who is starving because he insists on "tenaciously practicing his musty Morals," Brunt acts in a typically Cacklogallinian way. He advises the officer to attempt to bribe the Squabbaws to obtain court favor for him, and later, when the prime minister asks him about the encounter, Brunt says, "I told him what he desired, but that I declined troubling his Excellency with such Trifles."[61] Living in Cacklogallinia, then, Brunt has been exposed to a false morality.

As a result of his scientific venture, Brunt learned of a true morality. The spirits on the moon showed him the misery that accompanies avarice, self-interest, and hypocrisy. It was, of course, science that made the voyage possible and science that prepared the narrator's mind to accept this truth by reminding him of the glory of God. On the other hand, science also precipitated the financial ruin of Cacklogallinia. The correct use of science, then, is its moral use, according to the author. The man who tries to use science to gain money, fame, or power will fail.

Samuel Brunt, who through the course of his adventures becomes a good man and a complete man, is the only person in the story capable of benefiting from the voyage. The scientist is so involved in his philosophy that he fails to receive a moral lesson from the voyage. He is a creature who loves God and wishes to be good, but he wants to live only in the world of philosophy. He wants nothing more than to stay in the wonderful world he has discovered on the moon, but this cannot be. He is forced to return to a world ruled by vice, a world where science is influenced by the rich and the powerful. And, unlike Brunt, who has "found" himself by the end of the novel, the scientist has learned nothing to help him live in society. Back on earth, though this time on Brunt's side of the earth, "Volatilio apear'd to be quite out of his Element."[62] He and the other now thoroughly lost little chickens fly southward never to be seen again.

The scientist is viewed in The Voyage to Cacklogallinia as the man without a country, the bird fallen from the nest. His virtue is derived from a non-wordly knowledge of the works of God. His scientific understanding is quite admirable, but his work has detracted him from the study that leads to real virtue--the study of mankind. He has no knowledge of good and evil and is thus an easy pawn in the hands of the avaricious politician. When he is faced with problems he cannot solve with his specialized knowledge of the universe, he can only flutter helplessly around.

The Voyage to Cacklogallinia presented a more sympathetic picture of science than had appeared in other satirical works. The scientist is still viewed as a foolish character because he is so involved with science that he forgets his other human obligations. Unlike those virtuosos and projectors who came before him, however, he is able to do what he proposes. His dream of flying to the moon is not ridiculous, for he does arrive at the moon, though he is not able to find the gold he thought might be there. The voyage, also, is not altogether profitless. Both Brunt and Volatilio are spiritually enriched by the journey, and Brunt receives a valuable moral lesson as well. The scientist is not a hero, but he is so much better than the other Cacklogallinians that he seems worthy of pity, if not respect.

The scientist in *The Voyage to Cacklogallinia* is the latest projector figure that I have encountered in fiction. Though writers laughed at the attempts of the scientist to invent new devices to help mankind, the movement toward industrialization in England did not cease. In contrast to the writers of the first third of the century who felt that scientific projects were silly and would hurt men, by cheating them of their money, rather than help them, Samuel Johnson completely supported the scientific projector. In No. 99 of the *Adventurer*, October 16, 1753, Johnson writes:

> But there is another species of projectors, to whom I would willingly conciliate mankind; whose ends are

> generally laudable, and whose labours are innocent; who are searching out new powers of nature, or contriving new works of art; but who are yet persecuted with incessant obloquy, and whom the universal contempt with which they are treated, often debars from the success which their industry would obtain, if it were permitted to act without opposition.
>
> . . . .
>
> Projectors of all kinds agree in their intellects, though they differ in their morals; they all fail by attempting things beyond their power, by despising vulgar attainments, and aspiring to performances to which, perhaps, nature has not proportioned the force of man: when they fail, therefore, they fail not by idleness or timidity, but by rash adventure and fruitless diligence.
>
> That the attempts of such men will often miscarry, we may reasonably expect; yet from such men, and such only, are we to hope for the cultivation of those parts of nature which lie yet waste, and the invention of those arts which are yet wanting to the felicity of life. If they are, therefore, universally discouraged, art and discovery can make no advances. . . . Men, unaccustomed to reason and researches, think every enterprise impracticable, which is extended beyond common effects, or comprises many intermediate operations. Many that presume to laugh at projectors, would consider a flight through the air in a winged chariot, and the movement of a mighty engine by the steam of water, as equally the dreams of mechanic lunacy; and would hear, with equal negligence, of the union of the Thames and Severn by a canal, and the scheme of Albuquerque the viceroy of the Indies, who in the rage of hostility had contrived to make Egypt a barren desert, by turning the Nile into the Red Sea.
>
> Those who have attempted much, have seldom failed to perform more than those who never deviate from the common roads of action: many valuable preparations of chemistry, are supposed to have risen from unsuccessful enquiries after the grand elixer: it is, therefore, just to encourage those, who endeavour to enlarge the power of art, since they often succeed beyond expectation; and when they fail, may sometimes benefit the world even by their miscarriages.[63]

Johnson was willing to forgive the scientist's occasional foolishness, because he believed that through science human progress was possible. As the eighteenth century continued, writers became more willing to believe the claims of the scientist, because they could see changes occurring around them. When Johnson was born in 1709 there were no steam engines in use. In 1712 the first successful engine was built near Tipton. By 1716 the company formed by Newcomen, who had developed the engine, had built steam-engines in four English counties. By the 1720's they were building engines abroad. By the 1730's men were beginning to experiment with ideas for steam-ships. The improvements made in the steam-engine during the last half of the eighteenth century were even more impressive. In the 1760's and 70's Smeaton made numerous improvements on the Newcomen type engine. At the same time, James Watt was becoming interested in steam-engines, and by the 1780's he had developed the much more efficient rotative engine.[64] The development of the steam-engine is, of course, only one example of technological changes that were occurring in the eighteenth century. As work in science and technology began to reap results, it became harder for writers to accuse the scientist of accomplishing nothing. They began, instead, to look more seriously at the scientist's relationship to society and to consider his scientific failures less and his moral successes or failures more.

CHAPTER IV

THE NON-SATIRICAL SCIENTIST: THE SCIENTIST WITH MORAL POWER

Despite the ridicule of writers who created virtuoso and projector figures to demonstrate the folly of scientific pursuits, the scientists throughout the eighteenth century remained fairly consistent in their professed goals--to offer man a better understanding of God through the study of nature and to improve his life through the development of new sources of power. During the first part of the century, though they were aware of the importance of both objectives, many scientists emphasized the former goal while, during the last half of the century, their attention turned to the more practical benefits of science. They considered each objective, however, as part of the scientist's moral duty.

During the eighteenth century, writers became more willing to consider seriously the social role of the scientist. Poets, essayists, and occasionally novelists began to use non-satirical scientist figures to question the moral responsibilities of the scientist. They did not always agree in their conclusions. To some writers, the scientist was a morally superior figure, a man God used to demonstrate His goodness and power to other men. To others, the scientist displayed moral weaknesses. He became too proud of his own minor accomplishments or he became so involved in the pursuit of knowledge that he neglected his other human responsibilities. By looking at the scientists' claims and both the positive and negative responses to those claims made by writers throughout the century, we can see how the new science came to be accepted and how men first considered problems which might arise from the successful pursuit of the new philosophy.

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The early members of the Royal Society, to whom science was often just a pleasurable intellectual hobby, were very interested in the theological implications of science. In the late seventeenth and early eighteenth centuries, many books were published whose purpose was to show the greatness of God by demonstrating the order which exists in the world He created. Robert Boyle, one of the most respected members of the early Royal Society, felt that an increased devotion to God was one of the main benefits man could derive from scientific study. Between 1660 and 1663 he wrote a group of essays entitled "Some Considerations Touching the Usefulness of Experimental Natural Philosophy," in which he attempted to prove, among other things, that knowing natural philosophy is one of man's religious duties.

In the first group of essays, those which concern "the Usefulness of Experimental Philosophy principally as it relates to the Mind of Man," Boyle suggests,

> The two chief advantages, which a real acquaintance with nature brings to our minds, are, first, by instructing our understandings, and gratifying our curiosities; and next, by exciting and cherishing our devotion.[1]

God, he argues, created the world, first, for His own glory. Through His creation, God demonstrates three of his most important attributes. The vastness and complexity of the universe provides evidence of God's power; the intricate relationships between the parts of the whole universe exemplify God's wisdom; and the balance of nature which provides shelter and nourishment for all of God's creatures, even the most insignificant, demonstrates His goodness. A man who does not study nature, Boyle says, does not realize the extent of God's power, wisdom, and goodness and thus cannot worship Him so completely and devotedly as the man who has studied natural philosophy.[2]

The second purpose for the creation, Boyle suggests, is that God intended to provide for man. In order to derive the blessings from the universe that God, in His goodness, placed there, one must study nature. God expects men to study their surroundings. Boyle says, "indeed so far is God from being unwilling, that we should pry into his works, that by divers dispensations he imposes on us, little less than a necessity of studying them."[3] To prove this point, Boyle mentions numerous remedies for poisons and illnesses which are hidden in various plants, waiting for men to discover them and use them to help all mankind.

The other essays in the first section of Boyle's work are a theological defense of the study of natural philosophy, intended to refute the arguments of those who felt that the study of natural history encouraged atheism. He reaches the following conclusion:

> Thus you may see, that God intended the world should serve man, not only for a palace to live in, and to gaze on, but for a school of virtue, to which his philanthropy reserves such inestimable rewards, that the creatures can on no account be so beneficial to man, as by promoting his piety; by a competent degree of which, God's goodness hath made no less than eternal felicity attainable.[4]

So, Boyle argues, the study of natural philosophy can eventually lead men to accept God's greatest gift, eternal salvation. Science, then, is a very morally enriching study.

Not only did Boyle write in defense of religion and the importance of studying philosophy to achieve complete religious devotion, he also left in his will the sum of £50 per year to be used to establish a lectureship "for proving the Christian religion against notorious Infidels, viz. Atheists, Theists, Pagans, Jews, and Mahometans, not descending lower to any controversies, that are among Christians themselves . . ."[5] According to the will, each year a person was to be selected to preach eight sermons in defense of the Christian faith.

The first man selected to present the Boyle lectures was Richard Bentley, the Chaplain to Dr. Stillingfleet, Bishop of Worchester, and later to be one of the principal combatants in the scholarly feud that led to Swift's *Battle of the Books*. In his lectures, entitled "A Confutation of Atheism," which he delivered in 1692, Bentley used Newton's theories to attack the philosophy of Hobbes and Spinoza. He argued that Newton's discoveries proved the existence of a divine power continually working in the universe. Bentley decided to have his lectures published the next year, and, while preparing his manuscript for publication, wrote several letters to Newton to check the accuracy of some of his statements. One of Newton's replies demonstrates his interest in using philosophy to glorify God. "When I wrote my treatise about our system," he told Bentley, "I had an eye upon such principles as might work with considering men, for the belief of a Deity; and nothing can rejoice me more than to find it useful for that purpose."[6]

The Boyle lectures became the source for many books, like Bentley's, which demonstrated the attributes of God by discussing natural phenomena. Samuel Clarke's *Discourse Concerning the Being and Attributes of God*, which went through at least eight editions between 1705 and 1732, originated as the Boyle lectures for 1704. In a later work, Clarke defended Newton's philosophy against an attack by Gottfried Wilhelm Leibnitz, the German mathematician. Leibnitz was a friend of the Princess of Wales, who was quite interested in philosophy. On one occasion he warned her against Newton's philosophy, which he claimed encouraged the idea that the universe is completely mechanical. The Princess of Wales told Clarke of Leibnitz's letter; Clarke preached a sermon refuting the idea which he sent to Leibnitz; Leibnitz replied, and eventually Clarke published their entire correspondence. In the "Dedication," Clarke explained his feelings concerning the relationship between natural philosophy and religion.

> Christianity presupposes the Truth of Natural Religion. Whatsoever subverts Natural Religion, does consequently much more subvert Christianity: and whatsoever tends to confirm Natural Religion, is proportionably of Service to the True Interest of the Christian. Natural Philosophy therefore, so far as it affects Religion, by determining Questions concerning Liberty and Fate, concerning the Extent of the Powers of Matter and Motion, and the Proofs from Phenomena of God's Continual Government of the World; is of very Great Importance. 'Tis of Singular Use, rightly to understand, and carefully to distinguish from Hypotheses or mere Supposition, the True and Certain Consequences of Experimental and Mathematical Philosophy; Which do, with wonderful Strength and Advantage, to All Such as are capable of apprehending them, confirm, establish, and vindicate against all Objections, those Great and Fundamental Truths of Natural Religion, which the Wisdom of Providence has at the same time universally implanted, in some degree, in the Minds of Persons even of the Meanest Capacities, not qualified to examine Demonstrative Proofs.[7]

Another popular book which was a publication of a series of Boyle lectures was William Derham's Physico-Theology, which appeared in at least fifteen editions between

1713 and 1798. Derham explains that he was originally prompted to consider the ideas expressed in the sermons because "having the Honour to be a Member of the Royal Society, as well as a Divine, I was minded to try what I could do towards the Improvement of Philosophical Matters to Theological Uses . . ."[8]

Though the scientist did not always choose to emphasize his role as revealer of divine truth, he continued throughout the century to accept the idea that one purpose of science is to discover God's laws at work in nature. Stephen Hales, in his Vegetable Staticks, published in 1727, asserts that

> The searching into the works of Nature, while it delights and inlarges the mind, and strikes us with the strongest assurance of the wisdom and power of the divine Architect, in framing for us so beautiful and well regulated a world, it does at the same time convince us of his constant benevolence and goodness toward us.[9]

J. T. Desaguliers, in the "Dedication" to A Course of Experimental Philosophy, first published in 1734, describes the purpose of science:

> To contemplate the Works of God, to discover Causes from their Effects, and make Art and Nature subservient to the Necessities of Life, by a Skill in joining proper Causes to produce the most useful Effects, is the Business of a Science, the Grounds and Principles of which, I have the Honour to lay at Your Royal Highness's Feet.[10]

And Joseph Priestley, in the "Preface" to his Experiments and Observations on Different Kinds of Air, published in 1790, wrote:

> The best founded praise is that which is due to the man, who, from a supreme veneration for the God of nature, takes pleasure in contemplating his works, and from a love of his fellow creatures, as the offspring of the same all-wise and benevolent parent, with a grateful sense and perfect enjoyment of the means of happiness of which he is already possessed, seeks, with earnestness, but without murmuring or impatience, that greater command of the powers of nature, which can only be obtained by a more extensive and more accurate knowledge of them; and which alone can enable us to avail ourselves of the numerous advantages with which we are surrounded, and contribute to make our common situation more secure and happy.[11]

These three men were working in different scientific fields--botany, physics, and chemistry--and writing in different parts of the century. Each was interested in the practical benefits derived from scientific inquiry, but each also echoed the belief of the age that the scientist should discover things which would illustrate the power and goodness of the Creator. This belief in the moral power of the new philosophy had been stated by Bacon, had been repeated by Sprat, and had finally become part of the new philosophers' concept of the duty of science.

The public interest in the theological implications of science is demonstrated by the popularity of the published Boyle lectures and other books intended to refute atheism through science. Richard Blackmore's poem Creation, for example, published in 1712, appeared in new editions throughout the century. In Blackmore's words, the poem was intended to demonstrate "the self-existence of an Eternal Mind from the created and dependent existence of the universe, and to confute the hypothesis of the Epicureans and the Fatalists, under whom all the patrons of impiety, ancient or modern, of whatsoever denomination, may be ranged."[12] Of more interest than Blackmore's prose statement of his purpose, however, is his poetic statement, for it illustrates the emotional depth of the poem which so attracted Addison that he called it "one of the most useful and noble Productions in our English Verse,"[13]

> I meditate to soar above the skies,
> To heights unknown, through ways untry'd to rise:
> I would th' Eternal from his works assert,
> And sing the wonders of creating Art.
> . . . .
> See, through this vast extended theatre
> Of skill divine, what shining marks appear!
> Creating power is all around exprest,
> The God discover'd, and his care confest.
> Nature's high birth her heavenly beauties show;
> By every feature we the parent know.
> Th' expanded spheres, amazing to the sight!
> Magnificent with stars and globes of light,
> The glorious orbs, which Heaven's bright host
> compose,
> Th' imprison'd sea, that restless ebbs and flows,
> The fluctuating fields of liquid air,
> With all the curious meteors hovering there,
> And the wide regions of the land, proclaim
> The Power Divine, that rais'd the mighty frame.[14]

Thus Blackmore states in poetry the same philosophy that Boyle, the Boyle lecturers, and scientists throughout the century were expressing in prose. Throughout the world, they said, one sees various effects. Through science, a man can discover causes which produce those effects, and eventually he is led to assume the existence of a primary cause from which flows all other causes and their effects. Here he finds God.

For to design an end, and to pursue
That end by means, and have it still in view,
Demands a conscious, wise, reflecting cause,
Which freely moves, and acts by reason's laws;
That can deliberate, means elect, and find
Their due connection with the end design'd.
And since the world's wide frame does not include
A cause with such capacities endued;
Some other cause o'er Nature must preside,
Which gave her birth, and does her motions guide.
And here behold the cause, which God we name,
The source of beings, and the mind supreme;
Whose perfect wisdom, and whose prudent care,
With one confederate voice unnumber'd worlds
declare.[15]

The more one studies nature, the more one understands about God, the first cause, and so the study of science is almost a religious exercise.

In other non-scientific works, also, we see the public acceptance of the idea that a knowledge of science leads to a meaningful vision of God. In No. 393 of the Spectator, May 31, 1712, Addison writes,

> Natural Philosophy quickens this Taste of the Creation, and renders it not only pleasing to the Imagination, but to the Understanding. It does not rest in the Murmur of Brooks, and the Melody of Birds, in the Shade of Groves and Woods, or in the Embroidery of Fields and Meadows, but considers the several Ends of Providence which are served by them, and the wonders of Divine Wisdom which appear in them. It heightens the Pleasures of the Eye, and raises such a rational Admiration in the Soul as is little inferior to Devotion.[16]

It is not enough simply to enjoy the beauty of nature, Addison says. To truly worship through nature, one must understand it.

Some quarter of a century later, a writer for the Monthly Review made the same point while giving an account of a Royal Society meeting.

> We ourselves were present some few nights ago at a Meeting of the Society, when a paper model of a cell in an honey-comb was produced, which had been sent by that great ornament to mathematical knowledge, Professor McLaurin. Several strangers, introduced by some of the Fellows . . . began to discover in their faces a mixture of mirth and contempt, at seeing an object so trivial, which had been transmitted as far as from Scotland. But when the Professor's treatise, which accompanied the model, had demonstrated that it was beyond all mathematical power to assign another figure that would compose an equal number of cells in the same given space, their tittering gave place to silent confusion and astonishment; and the Great Creator, from this little piece of modelled paper, received the honour due to his immense wisdom, which had infused into the little architects of the honey-comb a kind of knowledge more than human.
>
> But, to do further justice to this respectable body, it is impossible, in the nature of things, that the importance of several of their communications should appear at once. The hints of one year may the next be carried on to experiments; and those experiments gradually open either a new, or an improved field of natural knowledge. . . . he that will take upon him to aver that the Royal Society of London have not made the noblest contributions to the advancement of these most useful sciences, must have more hardiness than either modesty or learning. He must utterly have forgot that there ever existed among them a Boyle, a Ray, or (*ille*! *O*! *Newton*! *Quot Aristoteles*!) the greatest philosopher the world ever did, or, it is to be feared, ever will see.[17]

The members of the Royal Society are here shown as advancers of the useful sciences and interpreters of God.

To cite another example from the last half of the century, Oliver Goldsmith began his *Survey of Experimental Philosophy*, published in 1775, with the following analogy:

> Let us for a moment compare this universe to a palace, erected by the divine Architect, and the unphilosophical spectator to a foreigner, who sees but the external part of the building. From so superficial a view it is evident he can have but an unsatisfactory

> idea of the skill and contrivance of the great Designer; he may perceive its beauties, but can have no idea of its conveniences. To have a more exact conception therefore, it is necessary to enter the building, to view each apartment separately, to consider the convenience of every room singly, with the symmetry and elegance of the whole.
>
> In the same manner the beauties of Nature strike our view, we find our curiosity allured by a variety of objects. Animals, vegetables, minerals, air, water, and fire, all put on different appearances to please, assist or astonish us; in order to come at a knowledge of their nature we must approach them closely; we must first consider each as divested of all their accidental qualities of figure and colour, and turn from Nature's external ornaments to view her internal simplicity.[18]

Each of these writers makes the same point--one way to truly worship God is to come to a philosophical understanding of the universe. Throughout the eighteenth century, scientists and non-scientists alike were willing to accept the scientist's role as revealer of religious truth. He became, to an extent, a prophet with the power to give men a vision of the Divine derived from nature rather than from scripture. As a result, certain scientists, and particularly Isaac Newton, became almost religious figures, so venerated as to make them seem super-human. In Spectator No. 554, the dramatist John Hughes discussed three scientists who he felt had "far outshot the generality of their Species, in Learning, Arts, or any valuable Improvements." The first, he said, was Sir Francis Bacon, who "by an extraordinary Force of Nature, Compass of Thought, and indefatigable Study, had amassed to himself such Stores of Knowledge as we cannot look upon without Amazement." Bacon, he continues,

> seems to have grasped All that was revealed in Books before his Time; and not satisfied with that, he began to strike out new Tracks of Science, too many to be travelled over by any one Man, in the Compass of the longest Life. These, therefore, he could only mark down, like imperfect Coastings in Maps, or supposed Points of Land, to be further discovered, and ascertained by the Industry of After-Ages, who should proceed upon his Notices or Conjectures.[19]

The second, Robert Boyle, Hughes said, "seems to have been designed by Nature to succeed to the Labours and Enquiries of /Bacon/ . . . His Life was spent in the Pursuit of Nature, through a great Variety of Forms and Changes, and in the most rational, as well as devout Adoration of its Divine Author."[20]

The third, though he is not named in the essay, is identified in Donald F. Bond's edition of The Spectator as Isaac Newton. Hughes describes him as "the Glory of our own Nation," and says of him,

> The improvements which others had made in Natural and Mathematical Knowledge have so vastly increased in his Hands, as to afford at once a wonderful Instance how great the Capacity is of an Human Soul, and how inexhaustible the Subject of its Enquiries; so true is that Remark in Holy Writ, that, tho a wise Man seek to find out the Works of God from the Beginning to the End, yet shall he not be able to do it.[21]

The purpose of Hughes's meditation on these men is, again, to show the greatness and goodness of God.

> It is impossible to attend to such Instances as these without being raised into a Contemplation on the wonderful Nature of an Human Mind, which is capable of such Progression in Knowledge, and can contain such a Variety of Ideas without Perplexity or Confusion. How reasonable is it from hence to infer its Divine Original? And whilst we find unthinking Matter indued with a Natural Power to last for ever, unless annihilated by

> Omnipotence, how absurd wou'd it be to imagine, that a Being so much Superior to it shou'd not have the same Privilege?[22]

To Hughes, great scientists like Bacon, Boyle, and Newton have helped prove, through their lives, that God is good and that progress is possible.

Though Hughes referred to Isaac Newton only indirectly, many other writers spoke of him by name with equal reverence. In No. 543 of the Spectator, Addison said:

> The more extended our Reason is, and the more able to grapple with immense Objects, the greater still are those Discoveries which it makes of Wisdom and Providence in the Work of the Creation. A Sir Isaac Newton, who stands up as the Miracle of the present Age, can look through a whole Planetary System; consider it in its Weight, Number, and Measure; and draw from it as many Demonstrations of infinite Power and Wisdom, as a more confined Understanding is able to deduce from the System of an Human Body.[23]

And in No. 635, Henry Grove, a popular nonconformist minister, said, "How doth such a Genius as Sir Isaac Newton, from amidst the Darkness that involves human Understanding, break forth and appear like one of another Species!"[24]

The many homages paid to Newton after his death, from Pope's

> Nature, and Nature's Laws lay hid in Night.
> God said, Let Newton be! and All was Light.[25]

to Cowper's

> Philosophy, baptiz'd
> In the pure fountain of eternal love,
> Has eyes indeed; and, viewing all she sees
> As meant to indicate a God to man,
> Gives him his praise, and forfeits not her own.
> Learning has borne such fruit in other days
> On all her branches: piety has found

> Friends in the friends of science, and true pray'r
> Has flow'd from lips wet with Castilian dews.
> Such was thy wisdom, Newton, childlike sage!
> Sagacious reader of the works of God,
> And in his word sagacious.[26]

are well known, and again demonstrate that Newton was considered by many to be a man far above other mortal men in wisdom. He was a divine gift, they felt, created to show men the true picture of the universe. Perhaps this feeling is best exemplified in James Thomson's elegy to Newton. In Thomson's poem the scientist was greater than poet or prophet, for he "Could trace the secret hand of Providence, /Wide-working through this universal frame."[27] The "pleasing visions" of the old philosophic schools fled like shadows at dawn, Thomson said, "When Newton rose, our philosophic sun!"

> O unprofuse magnificence divine!
> O wisdom truly perfect! thus to call
> From a few causes such a scheme of things,
> Effects so various, beautiful, and great,
> An universe complete! And O beloved
> Of Heaven! whose well purged penetrating eye
> The mystic veil transpiercing, inly scanned
> The rising, moving, wide-established frame.
> . . . .
> What wonder thence that his devotion swelled
> Responsive to his knowledge? For could he
> Whose piercing mental eye diffusive saw
> The finished university of things
> In all its order, magnitude, and parts
> Forbear incessant to adore that Power
> Who fills, sustains, and actuates the whole?[28]

This, of course, is not an accurate depiction of Sir Isaac Newton. Just as the weaknesses of the scientist were so emphasized in the characters of the virtuoso and the projector that he lost his humanness and appeared ridiculous and grotesque, so the strengths of Newton--his scientific genius and his religious devotion--removed from the context of his life and heightened by the elegiac tone, make him seem more angelic than human. Somewhere between the laughter and the awe, however, real scientists did exist. Sometimes when the non-scientist considered real men searching for new knowledge, they became skeptical.

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Throughout the eighteenth century there were various skeptical responses to the claim that scientific study was morally uplifting. One question the non-scientist raised was whether it was, indeed, the will of God that man should discover the secrets of nature--was the goal of the scientist valid? A second question sometimes asked by the skeptic was whether scientific study really had the power to make men moral, as Boyle, for example, had suggested it did. Closely related, and yet interestingly different, was a third question sometimes raised--did scientific study really have the power to make men happy?

The theme of those who questioned the validity of the scientists' goal was often the vanity of human wishes. Early in the eighteenth century Matthew Prior investigated this theme in his poem Solomon. Though Solomon seeks happiness from knowledge, from pleasure, and from power, he determines at last that he has sought in vain. All men can do, he decides, is to accept the will of God, "Whom no man fully sees, and none can see!"[29]

The scientists often used Solomon as a Biblical example of a wise man who was interested in natural philosophy, thus establishing a scriptural precedent for their own activities. Francis Bacon had named the philosophical institution in his utopia "Solomon's House." Robert Boyle, in his essays on the usefulness of natural philosophy, had used the Biblical account of Solomon to justify the study of science.

> But, Prophilus, to put it out of question, that the sublimest reason needs not make the proffessor of it think the study of physiology an employment below him, that unequalled Solomon, who was pronounced the wisest of men by their omniscient Author, did not only justify the study of natural philosophy, by addicting himself to it, but enobled it by teaching it, and purposely composing of it, those matchless records of nature, from which I remember some Jewish authors relate Aristotle to have borrowed . . .[30]

Stephen Hales, in the "Dedication" to the Vegetable Staticks, also used Solomon to support the suggestion that a wise man should study science.

> And as Solomon, the greatest and wisest of men, deigned not to inquire into the nature of Plants, from the Cedar in Lebanon, to the Hyssop that springeth out of the wall: So it will not, I presume, be an unacceptable entertainment to Your Royal Highness . . .[31]

Matthew Prior's Solomon, however, comes to the conclusion that the scientist cannot come to a better knowledge of either nature or God. After searching the earth and heavens, Solomon is left with a multitude of unanswered questions. He concludes that truth has been intentionally hidden from men.

> Thus while with fruitless Hope, and weary Pain,
> We seek great Nature's Pow'r, but seek in vain;
> Safe sits the Goddess in her dark Retreat;
> Around Her, Myriads of Ideas wait,
> And endless Shapes, which the Mysterious Queen
> Can take or quit, can alter or retain:
> As from our lost Pursuit She wills to hide
> Her close Decrees, and chasten human Pride.[32]

Furthermore, Solomon decides, even though man may use his reasoning ability to suppose there must be a primary cause and thus a deity, he still will know nothing of God, for He will not be bound by any system men can reason out.

> Then from whate'er We can to Sense produce
> Common and Plain, or wond'rous and abstruse,
> From Nature's constant or Eccentric Laws,
> The thoughtful Soul this gen'ral Influence draws,
> That an Effect must presuppose a Cause.
> And while She does her upward Flight sustain,
> Touching each Link of the continu'd Chain,
> At length she is oblig'd and forc'd to see
> A First, a Source, a Life, a Deity;
> What has for ever been, and must for ever be.
>
> This great Existence thus by Reason found,
> Blest by all Pow'r, with all Perfection crown'd;
> How can we bind or limit His Decree,
> By what our Ear has heard, or Eye may see?[33]

Science, Solomon says, cannot find truth. A wise man may create a fanciful explanation for the natural phenomena he observes, but that is a creation of his own mind. The mind of God remains hidden.

> Send forth, Ye Wise, send forth your lab'ring Thought:
> Let it return with empty Notions fraught,
> Of airy Columns every Moment broke,
> Of circling Whirlpools, and of Spheres of Smoke:
> Yet this Solution but once more affords
> New Change of Terms, and scaffolding of Words:

In other Garb my Question I receive;
And take the Doubt the very same I gave.[34]

Advocates of the new science had criticized the Aristotelians for basing their truth on words rather than on scientific facts. Prior says that all science is guilty of mistaking vocabulary for truth. The new science may establish new terms, he feels, but it will not discover new knowledge.

And so, Solomon is finally forced to conclude that it is vain to search for new scientific knowledge.

Forc'd by reflective Reason I confess,
That human Science is uncertain Guess.
Alas! We grasp at Clouds, and beat the Air,
Vexing that Spirit We intend to clear.
Can Thought beyond the Bounds of Matter climb?
Or who shall tell Me, what is Space or Time?
In vain We lift up our presumptuous Eyes
To what our Maker to their Ken denies:
The Searcher follows fast; the Object faster flies.
The little which imperfectly We find,
Seduces only the bewilder'd Mind
To fruitless Search of Something yet behind.
Various Discussions tear our heated Brain:
Opinions often turn; still Doubts remain;
And who indulges Thought, increases Pain.

How narrow Limits were to Wisdom giv'n?
Earth She surveys: She thence would measure Heav'n:
Thro' Mists obscure, now wings her tedious Way:
Now wanders dazl'd with too bright a Day;
And from the Summit of a pathless Coast
Sees INFINITE, and in that Sight is lost.[35]

Prior tries to show that man's ability to obtain scientific knowledge is limited, and thus the man who seeks pleasure in study is disappointed.

Other writers expressed doubt that the study of science would make a man moral. In order to be truly moral, they said, a man must understand himself and his fellow men as well as the works of God in the natural world. Pope, in the "Essay on Man," published in 1733-34, tells the scholar, "The proper Study of Mankind is Man."

> Go wond'rous creature! mount where Science guides,
> Go, measure earth, weigh air, and state the tides;
> Instruct the planets in what orbs to run,
> Correct old Time, and regulate the Sun.
> Go soar with Plato to th' empyreal sphere,
> To the first good, first perfect, and first fair;
> Or tread the mazy round his follow'rs trod,
> And quitting sense, call imitating God;
> As Eastern priests in giddy circles run,
> And turn their heads to imitate the Sun.
> Go, teach Eternal Wisdom how to rule--
> Then drop into thyself, and be a fool![36]

There are, then, limits to the moral benefits of scientific knowledge. Using Newton as an example of an exceptional scientist, as others before him had done, Pope shows that man is limited morally by his ability to know and control himself rather than by his capacity for understanding the universe.

> Could he /Newton/, whose rules the rapid Comet bind,
> Describe or fix one movement of his Mind?
> Who saw its fires here rise, and there descend,
> Explain his own beginning, or his end?
> Alas what wonder! Man's superior part
> Uncheck'd may rise, and climb from art to art:
> But when his own great work is but begun,
> What Reason weaves, by Passion is undone.[37]

Though the study of science will not necessarily make men moral, Pope says, the vices of men can make science ineffectual.

> Trace Science then, with Modesty thy guide;
> First strip off all her equipage of Pride;
> Deduct what is but Vanity, or Dress,
> Or Learning's Luxury, or Idleness;
> Or tricks to shew the stretch of human brain,

Mere curious pleasure, or ingenious Pain:
Expunge the whole, or lop th' excrescent parts
Of all, our Vices have created Arts:
Then see how little the remaining sum,
Which serv'd the past, and must the times to come![38]

Advocates of the new science had sometimes suggested that a man who studied science would see evidences of God and would have to become more moral as a result. Pope asks if there is not an alternative. Men might study science for other than moral reasons, and their study might yield other than moral results. In considering science as a neutral force with the power to be used for good or evil, Pope is agreeing with Bacon, who once said:

> If any one, in the last Place, should object, that the Arts and Sciences may be wrested, and turned to evil Purposes or Sin, Luxury, etc. this can have little Weight; because it may be said of all the best Things in the World, such as great Capacity, Courage, Strength, Beauty, Riches, Light itself, etc. Let but Mankind recover their Right over Nature, which was given them by the divine Being; let them be well provided of Materials, and _rectified Reason_, and _sound Religion_, will direct the Use.[39]

Pope sees science as a force "Which serv'd the past, and must the times to come," but he realizes that science is not, in itself, a moral power.

William Cowper makes a similar statement in Book III of _The Task_, published in 1785. Though he praised Newton, Cowper doubted that most men achieved anything of value through scientific study. Because of Newton's great piety, God allowed him to see the secrets of nature. He says, however that most men study nature to glorify themselves rather than God. These men are barred from truth and discover only

"Conclusions retrograde and mad mistake."

> God never meant that man should scale the heav'ns
> By strides of human wisdom. In his works
> Though wondrous, he commands us in his word
> To seek him rather, where his mercy shines.
> The mind indeed, enlighten'd from above,
> Views him in all; ascribes to the grand cause
> The grand effect; acknowledges with joy
> His manner, and with rapture tastes his style.
> But never yet did philosophic tube,
> That brings the planets home into the eye
> Of observation, and discovers, else
> Not visible, his family of worlds,
> Discover him that rules them; such a veil
> Hangs over mortal eyes, blind from the birth,
> And dark in things divine. Full often, too,
> Our wayward intellect, the more we learn
> Of nature, overlooks her author more;
> From instrumental causes proud to draw
> Conclusions retrograde, and mad mistake.[40]

Cowper and Pope are not arguing about the validity of the new science. They are seriously considering man's relationship to the search for knowledge. Each indicates that while science mixed with morality will yield truth, science without moral power will be useless or mistaken. Again, as in Swift, the scientist is responsible for his failures.

Closely related to the feeling that science could make men moral was the idea that it could make them happy. Boyle said that the study of nature would delight men because of the endless variety of phenomena. Such study would continually stimulate the intellect and satisfy the curiosity of man.[41] Hales said that scientific study "delights" and "inlarges" the mind.[42] And Priestley said that science would "never fail to furnish materials for the most agreeable and active pursuits . . ."[43] Samuel Johnson, in "The Vanity of Human Wishes," published in 1749, points out that scientific study does not exempt men from the pains of life. The scientist, he says, seeks happiness in fame which he probably will receive only after his death.

> When first the college rolls receive his name,
> The young enthusiast quits his ease for fame;
> Through all his veins the fever of renown
> Burns from the strong contagion of the gown;
> O'er Bodley's dome his future labours spread,
> And Bacon's mansion trembles o'er his head.
> Are these thy views? proceed, illustrious youth,
> And virtue guard thee to the throne of Truth!
> Yet should thy soul indulge the gen'rous heat,
> Till captive Science yields her last retreat;
> Should Reason guide thee with her brightest ray,
> And pour on misty Doubt resistless day;
> . . . .
> Yet hope not life from grief or danger free,
> Nor think the doom of man revers'd for thee:
> Deign on the passing world to turn thine eyes,
> And pause awhile from letters, to be wise;
> There mark what ills the scholar's life assail,
> Toil, envy, want, the patron, and the jail.
> See nations slowly wise, and meanly just,
> To buried merit raise the tardy bust.
> If dreams yet flatter, once again attend,
> Hear Lydiat's life, and Galileo's end.[44]

As I pointed out before, Johnson felt that any activity which might benefit mankind was of value. He did not believe, however, that a man would be happy just because he studied science. Nor did he believe that scientific knowledge was a substitute for moral virtue or religious faith. In the context of the whole poem, science is one of many things that men turn to when they are seeking happiness, but Johnson says that men will not find happiness on earth and should seek instead that religious faith which brings consolation.

Johnson uses the two astronomers in Rasselas to make something of the same point. Neither astronomer found happiness through his study. The Arab who captured Pekuah and held her for ransom was a man who studied the stars for his own pleasure, to try to escape boredom. But he hungered for an intellectual companion to share his knowledge with. He found in Pekuah someone intelligent enough to converse with him, though she had little real desire to pursue his study. Johnson shows through this episode that acquisition of knowledge alone is not enough to bring pleasure. The Arab needed a communion of minds which his women could not provide for him more than he needed the knowledge of the stars he acquired. Knowledge is not a real substitute for the pleasure of meaningful human relationships.

The other astronomer also discovered that science is not a good substitute for human companionship. Shortly after Pekuah is recovered, Rasselas and his companions become acquainted with a learned astronomer who believes he controls the weather. Imlac explains that the scientist's imagination has overpowered his ability to reason. Because he wanted his science to contain such power, because he continually dreamed that it might, he came at last to erroneously believe that it did. One cause of his madness is that he has removed himself from other people. Rasselas and his friends grow fond of the astronomer, who is a kind and virtuous man, and succeed in curing him by drawing his attention away from science. As he again becomes involved in human community, he begins to view his studies more rationally and relates to his friends the disadvantages of his scientific studies:

> Of the various conditions which the world spreads before you, which you shall prefer, said the sage, I am not able to instruct you. I can only tell that I have chosen wrong. I have passed my time in study without experience; in the attainment of sciences which can, for the most part, be but remotely useful to mankind. I have purchased knowledge at the expence of all the common comforts of life: I have missed the endearing elegance of female friendship, and the happy commerce of domestick tenderness. If I have obtained any prerogatives above other students, they have been accompanied with fear, disquiet, and scrupulosity; but even of these prerogatives, whatever they were, I have, since my thoughts have been diversified by more intercourse with the world, begun to question the reality.[45]

Though he believed in progress and often championed the cause of science, Johnson was skeptical of some of the scientists' claims. He did not believe that study alone could bring happiness. In fact, he felt that a scientific pursuit that so obsessed a man that he removed himself from the world was likely to be harmful and to bring unhappiness.

Throughout the eighteenth century, then, scientists were firmly maintaining that scientific study could make men more religious and thus happier and more virtuous. Some non-scientists completely backed this claim and urged men to support science. Others were more skeptical and argued that scientific study, though useful in its own way, was only a small part of life and that scientists, whatever their intellectual abilities, were subject to the same moral weaknesses as other men.

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Throughout the century, the scientist also persistently followed his other professed purpose--he tried to improve the physical world through his studies. Part II of Boyle's essays defending natural philosophy concerned the usefulness of that study. In the first essay of this group, Boyle explains his feelings concerning the practical aspects of natural philosophy.

> After having, in the former part of the treatise, Pyrophilus, thus largely endeavoured to manifest to you the advantageousness of natural philosophy to the mind of man, we shall now proceed to speak of its usefulness both to his body and fortune. For I must ingenuously confess to you, Pyrophilus, that I should not have near so high a value as I now cherish for phisiology, if I thought it could only teach a man to discourse of nature, but not at all to master her; and served only, with pleasing speculations to entertain his understanding, without at all increasing his power. And though I presume not to judge of other men's knowledge; yet, for my own particular, I shall not dare to think my self a true naturalist, till my skill can make my garden yield better herbs and flowers, or my orchard better fruit, or my field better corn, or my dairy better cheese, than theirs that are strangers to physiology.[46]

In the essays that follow, Boyle discusses the way in which natural philosophy can improve the study of the various branches of "physick"--physiology, pathology, the discovery and production of medicines, and other related fields.

Hales, in the "Preface" to the Vegetable Staticks, 1727, also professes interest in the practical benefits which might result from his studies.

> As the art of Physick has of late years been much improved by a greater knowledge of the animal oeconomy; so doubtless a farther insight into the vegetable oeconomy must needs proportionably improve our skill in Agriculture and Gardening, which gives me reason to hope, that inquiries of this kind will be acceptable to many, who are intent upon improving those innocent, delightful, and beneficial Arts . . .[47]

Later in the century, Erasmus Darwin, in the Zoonomia, 1794, said that practical benefits can arise from improved theories as well as new discoveries. His reason for writing the Zoonomia, he explains in the "Preface" is to "reduce the facts belonging to Animal Life into classes, orders, genera, and species; and, by comparing them with each other, to unravel the theory of diseases."[48] He explains this idea further by saying,

> The want of a theory . . . to conduct the practice of medicine is lamented by its professors; for, as a great number of unconnected facts are difficult to be acquired, and to be reasoned from, the art of medicine is in many instances less efficacious under the direction of its wisest practitioners; and by that busy crowd, who either boldly wade in darkness, or are led into endless error by the glare of false theory, it is daily practiced to the destruction of thousands . . .
>
> A theory founded upon nature, that should bind together the scattered facts of medical knowledge, and converge into one point of view the laws of organic life, would thus on many accounts contribute to the interest of society.[49]

Those engaged in the study of physics and chemistry were also convinced that their discoveries benefited man. Desaguliers felt that one purpose of science was to "make Art and Nature subservient to the Necessities of Life, by a Skill in joining proper Causes to produce the must useful Effects . . ."[50] Joseph Priestley, toward the end of the century, presented a more detailed defense of the study of science. He repeated the idea, prevalent in Bacon, Sprat, and Boyle, that one who understands nature can control it and benefit from its powers: "It is by increasing our knowledge of _nature_, and by this alone, that we acquire the great art of commanding it, of availing ourselves of its powers, and applying them to our own purposes . . ."[51] Priestley relates the power derived from knowledge to manufacturing and commerce rather than to agriculture or medicine.

> Considering your Royal Highness as destined to be the future sovereign of this country, I cannot wish you greater glory or happiness, than that you should consider it consisting, not in the _extent_, but in the _flourishing state_, of your dominions, to which _science_, _manufactures_, and _commerce_ (each the true source of the other) will most eminently contribute; and that you should not be dazzled by the flattering, but often fatal, idea of extending what is called the _royal prerogative_; but rather study to give your subjects every power which they can exercise for their own advantage.[52]

The interest in scientific advances displayed by the general public is demonstrated by the popularity of the scientific articles which appeared in the _Gentleman's Magazine_. When the periodical was first published in 1731, most of the articles concerned political and literary topics. The "Preface" to the 1741 volume indicates which parts of the magazine were the most popular.

> _Our Debates and Poetical Pieces are copied by some, our Foreign History by others, and the Lives which we have inserted of eminent Men, have been taken into Works of larger Size, and, with other Parts of our Book, been translated into foreign Languages._[53]

During the early years of the magazine's publication, scientific articles were included among the others because they provided a pleasing diversity. This is explained in the "Preface" to the 1743 volume.

> Though under a Form of Government like ours, which makes almost every Man a secondary Legislator, Politicks may justly claim a more general Attention than where the People have no other Duty to practice than Obedience, and where to examine the Conduct of their Superiors, would be to disturb their own Quiet, without Advantage, yet it must be owned, that Life requires many other Considerations, and that Politicks may be said to usurp the Mind, when they leave no Room for any other Subject.
> For this Reason, we have taken Care to diversify our Work, and have thought ourselves by no Means negligent of the publick Happiness, when we interspersed political Controversies with Dissertations on Morality, Commerce and Philosophy.[54]

Toward the middle of the century, particularly between the close of the War of the Austrian Succession (1748) and the beginning of the Seven Years' War (1755), the interest in politics declined and the interest in science increased. In the "Preface" to the 1749 volume, the editor says:

> Politics, which some years ago, took up a large field, is now reducible into a small compass; this topic having, from the memorable conduct of the most celebrated patriots, failed to engage attention: a change, though very sensibly felt by those who still pursue this subject to their loss, not at all to be regretted by the public, if Literature and Science, raised up from their great depression in the reign of Politics, shall again flourish with proportionable vigour.[55]

By 1753 much of the public interest in the Gentlemen's Magazine seems to have been produced by its scientific articles, for in the "Preface" to volume 23, the editor says:

> . . . as our book has been long considered as the medium, thro' which men of learning and genius correspond

> with each other, our own labour naturally diminished as the merit of our collection encreased; and as many of our correspondents resided in remote countries, its circulation became more extensive, and our success obtained greater stability; the benefit has indeed, in some degree, been mutual; many hints have been started in our collection which have produced enquiry, and these enquiries have seldom failed to produce new knowledge. We have illustrated natural philosophy, not only by cuts, but by colouring, and, that we might comprehend a greater variety of knowledge, we have added to those tracts which we originally published in our Miscellany, not a list only, but some account of the books that have appeared as well in our own as in foreign countries.[56]

The extent to which scientific subjects were discussed in the Gentlemen's Magazine greatly depended on the amount of political fervor in the country during the year. But interest in science never completely declined. In 1790, once again listing the accomplishments of the magazine, the writer of the "Preface" to the 60th volume mentions the periodical's contribution to scientific inquiry.

> Useful Inventions and Improvements in all Branches of Science, and even the Record of unsuccessful Projects, have regularly been registered in our Miscellany. The Admirers of Biography, which has become a favourite Amusement of the present Age, will find here the most copious Stores of Information . . . The Natural Historian, the Antiquary, the Philosopher, and the Studious in Polite Literature of every Description, may also meet with their favourite Object of Research, and mutually give and receive that Instruction which we are proud of being the Instruments of conveying to public Notice.[57]

The number of scientific articles which appeared in the Gentlemen's Magazine over one ten year period, 1748 to 1757, demonstrates not only the public interest in science but also the emphasis being placed on the practical sciences.

There were 1227 scientific or technological articles published during these years, an average of ten a month. Between 1750 and 1755, over 50% of the articles published each year concerned some area of scientific interest. The greatest number of articles (195) concerned medicine. Other areas of particular interest were zoology (156), inventions (144), meteorology (127), and astronomy (103). It is interesting to note that of the five areas of particular interest, three represent practical rather than abstract sciences.[58]

Throughout the century, then, both scientists and non-scientists were interested in the practical aspects of science. Furthermore, they were concerned with the moral implications of the rapid changes occurring around them. They wondered whether scientific advances were part of a divine plan to improve the world or whether they symbolized man's attempt to remove destiny from its proper source, the hand of God.

Joseph Priestley is an example of a scientist who firmly believed in divine providence. Unlike many of the writers mentioned above, he did not believe that a scientist's mistakes and failures resulted from moral indadequacy. A scientist who insisted on perfecting his work until he was sure it was correct in every detail, he said, slowed the advance of knowledge. Furthermore, because men do continually learn more things, even the greatest scientist's work cannot be complete.

> The greater is the circle of light, the greater is the boundary of the darkness by which it is confined. But, notwithstanding this, the more light we get, the more thankful we ought to be. For by this means we have the greater range for satisfactory contemplation. In time the bounds of light will be still farther extended; and from the infinity of the divine nature, and the divine works, we may promise ourselves an endless progress in our investigation of them: a prospect truly sublime and glorious. The works of the greatest and most successful philosophers are, on this account, open to our complaints of their being imperfect.[59]

So, a scientist should not worry about making mistakes or producing incomplete works. What one man cannot see, others who read his works might, and knowledge will continue to increase. Priestley also warns that discoveries are sometimes made because of luck. The man who has searched the most for a particular answer may not be the one who finds it. The scientist, then, because he is continually uncovering new ground, will often seem to be imperfect or foolish. " . . . this will ever be the case in the progress of natural science," he says, "so long as the works of God are, like himself, infinite and inexhaustible."[60]

But, even though science may appear imperfect at times, Priestley felt, it is controlled by a divine providence. " . . . the man who believes that there is a governor as well as a maker of the world (and there is certainly equal reason to believe both) will acknowledge his providence and favour at least as much in a successful pursuit of knowledge, as of wealth; which is a sentiment that intirely cuts off all boasting with respect to ourselves, and all envy and jealousy with respect to others; and disposes us mutually to rejoice in every new light that we receive, through whose hands soever it be conveyed to us."[61]

Priestley felt that the progress of science was a sign that divine providence was working in the world.

> . . . there appears to me to be a very particular providence in the concurrence of those circumstances which have produced so great a change; and I cannot help flattering myself that this will be instrumental in bringing about other changes in the state of the world, of much more consequence to the improvement and happiness of it.[62]

The advance of science, Priestley suggests, is part of a divine plan to improve every aspect of human life--to lead men toward an earthly paradise.

> This rapid process of knowledge, which, like the progress of a wave of the sea, of sound, or of light from the sun, extends itself not this way or that way only, but _in all directions_, will, I doubt not, be the means, under God, of extirpating _all_ error and prejudice, and of putting an end to all undue and usurped authority in the business of _religion_, as well as of _science_ . . .[63]

By the middle of the century, people were beginning to believe in progress. This is illustrated by the writer of the _Monthly Review_ article, quoted above, who said: "The hints of one year may the next be carried on to experiments; and those experiments gradually open either a new, or an improved field of natural knowledge," or by Samuel Johnson's assertion: "That the attempts of such men [the projectors] will often miscarry, we may reasonably expect; yet from such men, and such only, are we to hope for the cultivation of those parts of nature which lie yet waste, and the invention of those arts which are yet wanting to the felicity of life."[64] As the non-scientist began to envision an ever-changing world, he began to question the place of change in the divine plan.

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In 1751 two works often discussed as examples of early science fiction were published in England. Both books, _A Narrative of the Life and Astonishing Adventures of John Daniel_ and _The Life and Adventures of Peter Wilkins_, contain sympathetic scientist narrators. A major theme in each work is the relationship of science and providence, but the authors reach very different conclusions.

A Narrative of the Life and Astonishing Adventures of John Daniel, by Ralph Morris (a pseudonym, the real author remains unknown), is the story of a boy who ran away to sea, became stranded on an island, and eventually visited the moon, traveling on a flying machine invented by his son. John Daniel is forced to run away from home when his father's young second wife falls in love with him. He goes to sea, and the ship he is on encounters a terrible storm from which only he and one companion (who, at a propitious moment, turns out to be a woman) are saved. They create a rather pleasant life for themselves on an uninhabited island, have many children who in turn have children, and live at peace until one of the sons, who is an inventor, manufactures a flying machine. The last half of the book concerns the adventures John and his son Jacob have flying from place to place, trying to find their way back to the island.

There are several characters in the story who have traits or abilities associated with the scientist or technologist. One is John Daniel himself. As a young man, he tells the reader at the first of the book, "my greatest delight /was/ in bestowing my whole surplus time, in studying the powers and operations of mechanism, or in devising or practicing upon some mechanical contrivance or other . . ."[65]

Even though John had not formally studied science (he was an apprentice to his father who was a smith), his knowledge of mechanics was admirable. For example, before he set sail, he spent a night at an inn in Norwich, where he happened to overhear an argument between a smith and a watch-maker concerning the "powers of springs, levers, and weights." No one in the room seemed able to settle the controversy, so John decided to intervene.

> At length, perceiving they were not likely to come to a determination, I begged leave, though a stranger, to offer my opinion upon the state of the case; which they readily granting, I set them right in the point; for being neither of them connoisseures in the mystery they framed their argument from, they wanted terms, significantly, to make each intelligible to the other, which I supplying them with from my reading, and giving them proper definitions of the operations of the engines, they were discoursing of, I brought them to an agreement.[66]

Throughout the book, John uses his scientific knowledge for his own pleasure, His scientific enthusiasm is displayed, for example, in his curiosity. He enjoys describing in great detail the strange creatures he encounters on his island. On one occasion

> . . . the most horrible creature presented itself that I ever beheld: It was about the size of a small horse, with two strait horns, each a full ell long, standing directly upright; it had a very short back, and vast broad hinder feet, with short thick legs, and round buttocks; but its fore part was very tall, and stood very upright, on such broad feet as were behind, with long strait legs; its eyes were very small, and the head short, thick, and blunt, with a wide mouth and lips, almost like a horse's, a flat nose, but very broad, a short thick neck, and hairy, as was the top and back part of the head . . .[67]

So begins a description which continues for several pages. John describes with equal care Jacob's flying machine (though he admits he cannot explain the principles that cause it to work), but he is really not very interested in its practical application. He is curious to know how the machine works, but he really doesn't want to fly on it. As he says,

> I told [Jacob], I looked upon it as an ingeneous sort of a whim to try an experiment with, and that as I had seen it play, I was now satisfied it would fly, but advised him to come down for fear of any accident; for now I had gratified my curiosity, I desired to see no more of it.[68]

John's science is perfectly harmless. It provides pleasure for him and is occasionally useful when he has a problem to solve (at one point he determines that a wrecked ship has a hole in the bottom because the water levels inside and outside of the ship are always the same), but it does not significantly change his life or the lives of those around him.

To his son Jacob, however, who is another scientist or, more accurately, technologist figure, science has quite a different purpose. Jacob has a desire to see the world, particularly England, and he realizes that the only way he can escape the island is to build a flying machine. Jacob is much more dedicated to science than is John. He enjoys his life as an inventor so much that he refuses to marry. As John says,

> The eldest of the last three sons . . . having been instructed by me in the smiths way, was so ingenious at any device I set him upon, that from the least hint, he would perfect every scheme he prosecuted; but upon mentioning his marriage with his eldest sister of the second brood, he told me, he had other things in his head, and . . . that if he was married, it would rob him of more time than he chose to part with from his business.[69]

Jacob does not invent just for pleasure. He wants to use his flying machine to fulfill his desire to see the world. He convinces his father that they should take a test flight, not realizing how difficult it will be to gauge their speed and direction. John consents to the test flight, and so the second-generation scientist carries away his father. They quickly become lost and, in fact, never find their way back to the island.

The author is, I think, contrasting the scientists of the first part of the century with those who were concerning themselves with invention. Scientists like Boyle and Newton made discoveries that were fascinating to consider, satisfied the curiosity, brought men closer to God, but did not change the course of history (so it seemed). The inventor, however, can create things that will completely change men's lives and, according to this author, take them away from God's providence. The name of John's island is "The Island of Providence." While they were there, God had provided all they needed to live happily. When Jacob seeks to find more happiness through his invention, he is disappointed.

Jacob had built his machine so he could see the world. He was very disenchanted, however, with what he found. After visiting several different places, Jacob observes:

> Truly father . . . if your countrymen are but like the people you would have me quit with you, I shall repent my ever having left the Isle of Providence; for instead of that knowing creature you have always mentioned mankind to be, and the delight of his Maker; I have yet seen none of them, whose way of life seems to me a whit more rational in its station than a brute; nor one of them with whom I would change condition; for they all seem to have acted to the height of their satisfaction and aims . . .[70]

John tries to assure Jacob that there are good men in the world and that a person who knew geography and astronomy could successfully fly their machine to all the great cities of the civilized world, but Jacob decides he wants to study these sciences so he can safely fly back to the Island of Providence and visit his brothers. He never has a chance to do this, however, for they book passage on a whaler bound for England, and Jacob is killed during the voyage.

The science that carried Jacob away from the Island of Providence was not able to make him happy or improve his life. John also fails to benefit from the invention. When he reaches England he is an old man, and he dies shortly after telling his story. He never sees his wife and children again, but he learns from a Lapland prophet that his wife is dying of grief and his sons are fighting over his land. Though John left the Island of Providence quite by accident, his departure seriously disrupted his life and the lives of his wife and children. Technology, then, irrevocably changed the lives of everyone in his family.

Another important statement is made by a philosopher who appears in the last few pages of the book. John tells his story to an English parson who observes:

> . . . Mr. Daniel, says he, I would have quitted the imperial crown of these realms with pleasure, to have been where you have, and to have returned as safe; and was I a young man again, would tomorrow take my flight upon this your eagle. There is not so sublime a notion of the divine Being to be obtained by any other means, as arises from the contemplation of his works; then what a fountain of joy and delight, praise and gratitude, must spring up from the actual survey of them; I mean the remoter parts of them, those as yet, viewed but through a cloud, and only guessed at from imperfect hints and surmises. I would not only have gone to the Moon, our neighbour planet, but to Venus, nay Mars, Jupiter, and even Saturn himself, had my years lasted, should have been visited by me. O, I had there seen the order, regularity, and nice disposition of Jupiter's satellites, and discovered the use of Saturn's ring; I had observed the form, the designs, the exercise, the faculties of the several species of inhabitants; united my voice to theirs, in praising our great Creator and Preserver; and whether ever I had returned or not, what had it

> mattered, so that my soul had been filled with the sense of those mighty works of creation, and of the omnipotent Agent that performed it all.[71]

The author, then, is not completely condemning the flying machine. Used within the realm of divine providence to give men a greater appreciation of the works of creation, it might be a very beneficial invention. What the author does seem to reject is the idea that inventions are part of a divine plan to improve the earth. His final statement rather ambiguously expresses this feeling. "Having now conducted my reader through a series of uncommon adventures," he writes, "let him remember that life is but a journey, and the grave his home."[72] The author realizes that science can change the world by introducing new machines that can turn men's lives in completely new directions, but he is unsure whether men can benefit from these changes. So, he concludes with the fatalistic reminder that we are all destined to live and die. Nothing man can do, with or without science, can change that fact. It is best, then, for men to try to remain, throughout their lives, within the will of God.

The Life and Adventures of Peter Wilkins, by Robert Paltock, also published in 1751, contains a much more optimistic picture of the relationship between science and providence. Wilkins is another unfortunate man who is forced to flee family difficulties by going to sea. After experiencing many hardships and narrow escapes, he finds himself all alone on a wrecked ship near the South Pole. He there discovers a subterranean passage which leads him to a world where he eventually discovers a race of flying people. Peter is able to use his knowledge to bring peace to their land, to help them develop trade and technology, and to establish among them the Christian religion.

Like John Daniel, Wilkins has not been formally taught natural philosophy. He attended an academy for a few years and learned to read and write Latin, but he never attended a university or engaged in a technological trade. He learned, not from books, but from experience. He first discovers the benefits of natural knowledge from Glanlepze, an African with whom he escapes from slavery. Glanlepze saves them from a crocodile by gagging and blinding the creature. When Peter seems astonished at this feat, Glanlepze tells him:

> Why Peter . . . there is nothing but a Man may compass by Resolution, if he takes both Ends of a Thing in his View at once, and fairly deliberates on both Sides, what may be given and taken from End to End. What you have seen me perform, is only from a thorough Notion I have of this Beast, and of myself, how far each of us hath Power to act and counter-act upon the other, and duly applying the Means.[73]

This lesson--that man has a power in knowledge that allows him to overcome more powerful obstacles in nature--is one Peter never forgets.

Throughout his adventures, Peter learns the benefits of experience and experiment. He discovers that, through experiment, one can often find natural explanations for mysterious happenings. When Peter's ship crashes into the rocks near the South Pole, he finds that certain objects begin flying around in apparently irrational ways. His first response is to believe that spirits are aboard his ship, but he soon discovers, through observation and experiment, that the ship has struck an enormous loadstone and that any free iron object will fly toward it.

> About a week after, as I was . . . putting on a new Pair of Shoes which I found on Board . . . taking out my Iron Buckles, I laid one of them upon a broken Piece of the Mast that I sat upon; when, to my Astonishment, it was no sooner out of my Hand, but up it flew to the Rock, and stuck there. I could not tell what to make of it; but was sorry the Devil had got above Deck. I then held several other Things, one after another, in my Hand, and laid them down where I laid the Buckle, but nothing stirred, till I took out the Fellow of that from the Shoes; when letting it go, away it jumped also to the Rock.
>
> I mused on these Phenomena for some Time, and could not forbear calling upon God to protect me from the Devil . . . But at Length Reason got the better of these foolish Apprehensions, and I began to think there might be some natural Cause of them, and next to be very desirous of finding out. In order to this I set about making Experiments, to try what would run to the Rock, and what would not.[74]

So, Peter makes a discovery which frees him from needless fear and superstition--false religious beliefs.

After he journeys underground, Peter spends several years living alone before he is discovered by the flying people. While he is building himself a place to stay and trying to discover things he can eat, he performs numerous simple, practical experiments. He thus discovers which plants are edible, which can be improved by cooking, and which can be used to make tools, like rope and fish nets.

He discovers a type of beast, which he describes with the accuracy of a natural philosopher, whose meat is not fit to eat but whose carcass yields oil he can burn for light. So Peter learns to use the basic tools of the scientist, observation and experience, to improve his physical as well as his spiritual life.

The more important comment on science, however, appears in the last half of the book, when Peter uses his knowledge to change a civilization. As in John Daniel, the question raised by his decision to introduce science and technology into the society of flying people concerns the relationship between scientific advancement and divine providence. The author seems to determine that God takes care of uncivilized men, but that He also provides means for their advancement.

Peter Wilkins was not really interested in using science to find evidences of God's presence in the world, but he did reflect on the goodness of God when he realized how fully he had provided for the needs of the Swangeantines--the flying men. Toward the end of the book, he observes:

> I have often reflected with myself, and have been amazed to think, that so ingenious and industrious a People . . . who till I came amongst them, had nothing more than bare Food, and a Hole to lie in, in a rocky Country, and then seemed to desire only what they had; should in ten Years time, be supplied not only with the Conveniences, but Superfluities of Life; and that they should then become so fond of them, as rather willing to part with Life itself, than be reduced to the State I found them in. And I have as often on this Occasion reflected on the Goodness of Providence, in rendering

> one part of Mankind easy under the Absence of such Comforts, as others could not rest without; and have made it a great Argument for my Assent to well-attested Truths above my Comprehension. For, says I, to have affirmed at my first coming, either that these things could hâve been made at all, or when done could have been of any additional Benefit to these People, would have been so far beyond their Imaginations, that the Reporter of so plain a Truth, as they now find it, would have been looked upon as a Madman or an Imposter: But by opening their Views by little and little, and shewing them the Dependance of one thing upon another; he that should now affirm the Inutility of them, would be observed in a much worse Light. And yet, without any Imbellishments of Art, how did this so great a People live under the Protection of Providence? Let us first view them at a vast Distance from any sort of Sustenance, yet from the Help of the Graundee [their wings], that Distance was but a Step to them. They were forced to inhabit the Rocks, from an utter Incapacity of providing Shelter else where, having no Tool that would either cut down Timber for an Habitation, or dig up the Earth for a Fence, or Materials to make one: But they had a Liquor that would dissolve the Rock itself into Habitations. . . . Their Fruits were dangerous, till they had fermented in a boiling Heat; and they had neither the Sun, or any Fire, or the Knowledge how to propagate or continue it. But they had their hot Springs always boiling, without their Care or Concern.[75]

Peter continues to cite incident after incident to prove that God had provided for these people those things which they could not provide for themselves.

It would seem from this description that the people were innocently at peace in their prosperous ignorance and that Peter, by bringing them technology, had disrupted their lives. And it is true that, at one point in the book, he questions the actual benefit of the changes he has introduced.

> . . . I found . . . that all the Riches they possessed were only Food and Slaves; and, as I found afterwards when amongst them, they know the want of nothing else:

> But, I am afraid, I have put them upon another way of thinking, tho' I aimed at what we call civilizing of them.[76]

There are, then, disadvantages of progress. But the story makes quite clear that the advancements Peter introduces are part of a divine plan and are necessary for the survival of the Swangeantines. Though the people were not in physical want, their country was not at peace. Rebellion from the western lands, political intrigue in the court, and a false religion propagated by unworthy priests threatened to destroy the country. The people feared that they would not be able to withstand an attack from the west, and that they would be overcome and taken into slavery. Peter consents to help the people out of their state of civil strife and religious and technological ignorance because he believes God wants him to intervene. A prediction or prophesy which has been part of the religion of the country for many years states that,

> . . . the West shall be divided from the East, and bring Sorrow, Confusion, and Slaughter, till the Waters of the Earth shall produce a Glumm, with Hair round his Head, swimming and flying without the Graundee; who, with unknown Fire and Smoak, shall destroy the Traitor of the West, settle the ancient Limits of the Monarchy, by common Consent establish what I would have taught you /Christianity7, change the Name of this Country, introduce new Laws and Arts, add Kingdoms to this State, and force Tributes from the Bowels of the Earth, of such things as this Kingdom shall not know till then, and shall never afterwards want; and then shall return to the Waters again. Take care . . . you miss not the Opportunity when it may be had; for once lost, it shall never, never more return; and then wo, wo, wo, to my poor Country.[77]

After much discussion, Peter is convinced that it is he who is intended to fulfill the prophecy. When his wife asks him how he can accomplish all these things, he answers, "never fear that. If this is from above, Means will soon be found; Providence never directs Effects without Means."[78]

Peter does fulfill the prophesy. His means are his ingenuity and the weapons he has brought with him from his technological society. He builds a platform which can be carried by several of the Glumms so that he can "fly without the Graundee"; he uses the cannon and firearms from the ship to put down the rebellion; he instructs the people in the Christian religion and, before he leaves, translates the Bible into their language and teaches them to read it; he establishes manufacturing and promotes trade with other lands and is able, through peaceful negotiations, to extend the boundaries of the kingdom. Though it is probably true that Peter does not leave the Swageantines a perfect society, he certainly leaves them a more peaceful and prosperous society than the one he found.

Though Paltock recognizes that science and technology can change lives, can create wants and needs where they did not exist before, he believes that God uses Science and technology to promote individual happiness, safety, and comfort (as Peter finds in the first half of the book) and to advance the peace and happiness of countries by making them more civilized.

The scientists in both John Daniel and Peter Wilkins are good, virtuous men. Peter Wilkins, however, is a real hero. He is everything that the virtuoso and the projector were not. He is successful where they failed; he is concerned with mankind and uses his science for the good of a people rather than being so involved in science that he forgets his other obligations; he attempts seemingly impossible things, but with the help of God he advances not only science but politics and religion as well, whereas they caused chaos all around them.

Both John Daniel and Peter Wilkins, however, live under the wing of divine providence. John Daniel, the reader feels, is not responsible for the evil that results from his journey. Peter Wilkins heroically follows the lead of providence, but he does not have to feel responsible for his successes. If his technology has given the people new desires and needs, then that was the will of God. Peter Wilkins, because he is fulfilling divine prophesy, does not carry the burden of responsibility for his success that Dr. Frankenstein, we feel, must bear for his scientific discovery. Even though the scientist in the eighteenth century became, at times, the figure of a good man, even an heroic man, he was not a complete man, because he was not faced with complicated moral choices. The scientist figure in literature does not become completely human until Mary Shelley creates in Frankenstein a man who knows that he and he alone controls the power he has captured from nature.

Of the views presented in John Daniel and Peter Wilkins of the relationship between science and divine providence, the people of the eighteenth century seemed more willing to accept the latter, if publication records are any indication of popularity. Peter Wilkins went through four editions in the eighteenth century, John Daniel only two. There were, of course, some people who realized that the power scientists and technologists were gaining could prove to be dangerous in the hands of immoral people. Samuel Johnson, for example, in Rasselas, considers the problem of the danger of a successful flying machine. His mechanic, whose attempts to fly, even though he is morally inclined, are unsuccessful, tells Rasselas:

> If men were all virtuous . . . I should with great alacrity teach them all to fly. But what would be the security of the good, if the bad could at pleasure invade them from the sky? Against an army sailing through the clouds neither walls, nor mountains, nor seas, could afford any security.[79]

Perhaps Johnson was more capable than others of viewing the potential danger of science because he was able to believe in progress without believing that advancement would lead to an earthly paradise. He believed, instead, that paradise must be reserved for heaven. For many others, however, belief in progress meant progress toward utopia. In the early nineteenth century, one such man was Humphrey Davy. His vision of the tremendous potential of science, I believe, led Mary Shelley to create the character of Dr. Frankenstein, the scientist with the power to create destruction.

CHAPTER V

FRANKENSTEIN: THE SCIENTIST WITH DESTRUCTIVE POWER

In Mary Shelley's _Frankenstein_ there is a scientist figure who, though he is an admirable human being, has gained a fearful power--he can create a potentially destructive force and loose it on the world. The scientist who has gained this power is not foolish, as was the virtuoso; his scientific goals are not unreasonable nor his projects unsuccessful, as were those of the projector. However, he is not under the care of divine providence, as were the non-satirical moral scientists. He engages in a successful experiment based on a credible idea and intended to benefit mankind, but instead of creating a new source of life, he introduces into the world a death force which he does not have the power to control.

Throughout _Frankenstein_, Mary Shelley, like those who created scientist characters before her, was considering the role of science and the scientist in society. The nineteenth-century scientist felt that science itself was a power that, almost of necessity, would improve the world. The scientist was the hero who would bring about these changes, who would control and direct an inevitable progress. One of Mary Shelley's purposes in writing Frankenstein was to test this theory, to question whether a noble scientist, working within the ideals of a noble science, would always create something good. On a larger scale, she was investigating the definition of man implicit in the scientific philosophy.

In October 1816, during a period when she was working on Frankenstein almost every day, Mary Shelley recorded in her Journal that she was reading Sir Humphrey Davy's "Chemistry." The entry in her reading list for the year refers to the work as the "Introduction to Davy's Chemistry."[1] This was the only scientific work she mentioned reading while she was writing Frankenstein. Frederick L. Jones, the modern editor of Mary Shelley's Journal, suggested that she was referring to Davy's Elements of Chemical Philosophy, which Shelley had ordered in 1812,[2] or the Elements of Agricultural Philosophy, published in 1813.[3] Neither of these works seems to illuminate the themes of the novel so well as does a third publication of Davy's, the "Discourse Introductory to a Course of Lectures on Chemistry," published in 1802. The difference in the tones of the three and the audiences they were addressed to is significant. The Elements of Chemical Philosophy is an introduction to physical chemistry written for chemists and does not closely relate to the experiments in physiological chemistry performed by Frankenstein. The "Introduction" to the volume consists of a long, detailed history of physical chemistry from the time of the ancient Egyptians to the early 1800's. The Elements of Agricultural Philosophy is addressed to an audience of landowners interested in increasing the yield of their crops. The work concerns living organisms, but the discussion is limited to plant life. Its "Introduction" is simply a summary of the topics which will be discussed in the chapters which follow.

The "Discourse Introductory to a Course of Lectures on Chemistry," however, is quite different from the other two. It originated as an introduction to a series of chemistry lectures which Davy delivered at the Royal Institute of Great Britain in 1802. The audience he was addressing was a gathering of interested London people, not chemists or even scientists for the most part. The intent of the "Discourse," Davy explained in an advertisement preceding the work, was "to excite feelings of interest concerning /chemistry/" rather than "to give minute information."[4] In order "to excite feelings of interest" Davy tells his audience that science will do remarkable things; not only will it continue to increase knowledge and improve life by aiding agriculture and technology, but it will also create a more peaceful society and provide happiness and hope for individual men.

Davy's "Discourse" can be viewed as the ultimate scientific promise. It reinforces everything the new philosophers had claimed science could do for man--it envisions a technological and social utopia made possible through people's interest in science. I believe that Mary Shelley read Davy's "Discourse" while she was writing Frankenstein, that she made Dr. Frankenstein a perfect scientist according to Davy's definition, and that she then tried to show that science might ultimately lead not to public good but to destruction for both the individual and society.

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Davy begins his discourse by explaining that chemistry "is that part of natural philosophy which relates to those intimate actions of bodies upon each other, by which their appearances are altered, and their individuality destroyed."[5] Chemistry, that is, is the study of the forces that cause change in the physical world. When hydrogen and oxygen are mixed in the proper proportions, for example, they each lose their individual properties and become a different substance--water. Chemistry, Davy says, is related to all the other sciences, for it provides new knowledge which advances the study of physics, natural history, mineralogy, botany and zoology, medicine and physiology, and even astronomy. The relationships between the sciences, he stresses, are more important than their differences. For this reason, a good scientist will never limit himself to the study of only one discipline.

> The man of true genius who studies science in consequence of its application,--pointing out to himself a definite end, will make use of all the instruments of investigation which are necessary for his purposes; and in the search of discovery, he will rather pursue the plans of his own mind than be limited by the artificial divisions of language. Following extensive views, he will combine together mechanical, chemical, and physiological knowledge, whenever this combination may be essential; in consequence his facts will be connected together by simple and obvious analogies, and in studying one class of phaenomena more particularly, he will not neglect its relations to other classes.[6]

Davy continues by pointing out the practical value of chemistry. It has been used, he says, to improve agriculture, metallurgy, the techniques of bleaching and dying, tanning, and porcelain and glass making. So Davy, like those who came before him, stresses the practical benefits of science. He is able, writing in 1802, to prove the usefulness of science by reminding the audience of those things science has done as well as noting the things science might do.

But, Davy continues, chemistry has provided man with more than new knowledge and new industrial processes. Through chemistry man has gained a power over nature.

> By means of this science man has employed almost all the substances in nature either for the satisfaction of his wants or the gratification of his luxuries. Not contented with what is found upon the surface of the earth, he has penetrated into her bosom, and has even searched the bottom of the ocean for the purpose of allaying the restlessness of his desires, or of extending and increasing his power. He is to a certain extent ruler of all the elements that surround him; and he is

> capable of using not only common matter according to his will and inclinations, but likewise of subjecting to his purposes the ethereal principles of heat and light. By his inventions they are elicited from the atmosphere; and under his control they become, according to circumstances, instruments of comfort and enjoyment, or of terror and destruction.[7]

The power he has obtained, Davy believes, distinguishes man the thinker, the civilized being, from man the animal, the savage. Though he realizes that any power can be used for good or evil, he feels that man can control the powers he creates and that power itself is a positive force, in fact, a gift from God.

> Man, in what is called a state of nature, is a creature of almost pure sensation. Called into activity only by positive wants, his life is passed either in satisfying the cravings of the common appetites, or in apathy, or in slumber. Living only in moments he calculates but little on futurity. He has no vivid feelings of hope, or thoughts of permanent and powerful action. And unable to discover causes, he is either harassed by superstitious dreams, or quietly and passively submissive to the mercy of nature and the elements. How different is man informed through the beneficence of the Deity, by science and the arts! Knowing his wants, and being able to provide for them, he is capable of anticipating future enjoyments, and of connecting hope with an infinite variety of ideas. He is in some measure independent of chance or accident for his pleasures. Science has given to him an acquaintance with the different relations of the parts of the external world; and more than that, it has bestowed upon him powers which may be almost called creative; which have enabled him to modify and change the beings surrounding him, and by his experiments to interrogate nature with power, not simply as a scholar, passive and seeking only to understand her operations, but rather as a master, active with his own instruments.[8]

It is interesting to note that though Davy says that God gave to civilized men the gift of science and art, his vision of the purpose of science is very worldly. Davy, for example, does not question whether the desires of men are good. He simply says that finding the power necessary to fulfill men's desires is good. When he speaks of hope, Davy is referring to the hope of a more prosperous future, not of a heavenly bliss. Furthermore, he is not interested in a science that simply helps men understand nature, which scientists before him said would help them praise God. To Davy, real science must give men a power over nature. In seeking this power, however, he is in no way being unreligious. As men came to believe in progress, their ideas concerning God's will changed. If one can believe in a deity who wishes men eternal bliss, one can also believe in a loving God who provides means for man's temporal happiness as well.

Davy continues by discussing the way science has progressed. Before we can plan for the future, he says, we must see what ground has been covered in the past, another idea he shares with Bacon and those who supported the new philosophy. In the past, chemists were influenced by "vague ideas, superstitious notions, and inaccurate practices." They too quickly drew visionary implications from their early discoveries and thus began "to institute researches after imaginary things" or "they employed them [the discoveries] as instruments for astonishing and deluding others." Thus were born "the dreams of alchemy concerning the philosopher's stone, and the elixer of life."[9]

But, from these early, undistinguished beginnings arose a new science with real powers.

> These views of things have passed away, and a new science has gradually arisen. The dim and uncertain twilight of discovery, which gave to objects false or indefinite appearances, has been succeeded by the steady light of truth, which has shown the external world in its distinct forms, and in its true relations to human powers. The composition of the atmosphere, and the properties of the gases, have been ascertained; the phaenomena of electricity have been developed; the lightnings have been taken from the clouds; and lastly, a new influence has been discovered, which has enabled man to produce from combinations of dead matter effects which were formerly occasioned only by animal organs.[10]

These are some of the things man has already done. His success gives him reason to have great hopes for the future.

> Science has done much for man, but it is capable of doing still more; its sources of improvement are not yet exhausted; the benefits that it has conferred ought to excite our hopes of its capability of conferring new benefits; and in considering the progressiveness of our nature, we may reasonably look forward to a state of greater cultivation and happiness than that we at present enjoy.[11]

Among the things Davy feels science will do is to create a more perfect society. All men of all classes will someday be united in a common effort to improve the world.

> In reasoning concerning the future hopes of the human species, we may look forward with confidence to a state of society in which the different orders and classes of men will contribute more effectually to the support of each other than they have hitherto done. . . . The guardians of civilization and of refinement, the most powerful and respected part of society, are daily growing more attentive to the realities of life; and, giving up many of their unnecessary enjoyments in consequence of the desire to be useful, are becoming the friends and protectors of the labouring part of the community. The unequal division of property and of

> labour, the difference of rank and condition amongst mankind, are the sources of power in civilized life, its moving causes, and even its very soul, and in considering and hoping that the human species is capable of becoming more enlightened and more happy, we can only expect that the great whole of society should be ultimately connected together by means of knowledge and the useful arts; that they should act as the children of one great parent, with one determinate end, so that no power may be rendered useless, no exertions thrown away.[12]

If you provide men with scientific power, which is available to all men, Davy says, they will have less need for social power, and they will be more capable of working together in peace.

Not only will science improve society as a whole, it will also improve the lives of individuals. Davy echoes the eighteenth-century scientist again when he says that the pursuit of knowledge, because it provides a goal that is never fully reached, can be a continual source of pleasure for man.

> . . . we cannot but perceive that the contemplation of the various phaenomena in the external world is eminently fitted for giving a permanent and placid enjoyment to the mind. For the relations of these phaenomena are perpetually changing; and consequently they are uniformly obliging us to alter our modes of thinking.[13]

The study of science will also satisfy man's desire for beauty.

> The study of nature, therefore, in her various operations must be always more or less connected with the love of the beautiful and sublime; and in consequence of the extent and indefiniteness of the views it presents to us, it is eminently calculated to gratify and keep alive the more powerful passions and ambitions of the soul, which, delighting in the anticipation of enjoyment, is never satisfied with knowledge; and which is as it were nourished by futurity, and rendered strong by hope.[14]

And finally, the study of science will instill in all men a love for order, both divine and social, which will make them better men.

> From observing in the relations of inanimate things fitness and utility, he will reason with deeper reverence concerning beings possessing life; and perceiving in all the phenomena of the universe the designs of a perfect intelligence, he will be averse to the turbulence and passion of hasty innovations, and will uniformly appear as the friend of tranquillity and order.[15]

So, Davy uses the old idea that science makes men more moral because it reminds them of the greatness of God to provide his vision of an almost infinitely powerful science with a moral safety valve. Even as science gives men power, which Davy admits can be used for good or evil, it will make them more perfect beings, thus almost insuring that they will use their power wisely. Davy does not, I think, envision a divine providence that personally directs the world. Rather he sees an earth full of natural and human potential, waiting for men to create goodness and happiness.

Davy suggests, in the "Discourse," a system which he says will almost guarantee progress for individual men and for civilization. He believes that a man who will steadfastly proceed in the investigation of a scientific problem from the perspective of all the sciences will succeed in discovering new ways to use the power of nature. The process, he suggests, will benefit the individual by fulfilling his desire for knowledge, for beauty, and for creative power.

For mankind, the process will provide new products, new sources of power, and a more equal class structure.

Almost everything that Davy says had been said before. For almost two hundred years, since the time of Francis Bacon, men had claimed that science could bring individual happiness and could, at the same time, benefit all of mankind. Joseph Priestley had suggested that the study of science would, "like the progress of a wave of the sea, of sound, or of light from the sun" extend its influence and become "the means, under God, of extirpating all error and prejudice"[16]--that science could advance civilization socially as well as scientifically. Priestley also believed that progress was limitless. He said:

> In like manner, science advancing, as it does, with an accelerated progress, it may be taken for granted, that mankind some centuries hence will be as much superior to us in knowledge, and improvements in the arts of life, as we now are to the Hottentots, though we cannot have any conception what that knowledge, or what those improvements, will be. It is enough for us to see that nature is inexhaustible, that it is a rich mine, in which we shall never dig in vain, and that it is open to infinitely more labourers than are now employed in exploring its contents, or in digging for them.[17]

But, even though Davy is reflecting the dream of the scientist for two hundred years, his vision of an ever-improving world, both technically and morally powered by science, must have been quite moving for his London audience. History has demonstrated that the philosophy expressed by Davy and other advocates of science was gratefully accepted by many people who wanted to believe men were capable of producing an ideal world.

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Mary Shelley, I believe, read Davy's "Discourse" and decided to test his theories concerning the potential benefits of scientific study. Victor Frankenstein fulfills all of Davy's requirements for a good scientist, yet his study benefits neither himself nor mankind.

Frankenstein relates that he was born with an inclination toward the sciences which increased as he grew older.

> While my companion contemplated with a serious and satisfied spirit the magnificent appearances of things, I delighted in investigating their causes. The world was to me a secret which I desired to divine. Curiosity, earnest research to learn the hidden laws of nature, gladness akin to rapture, as they were unfolded to me, are among the earliest sensations I can remember.
> . . . .
> I confess that neither the structure of languages, nor the code of governments, nor the politics of various states, possessed attractions for me. It was the secrets of heaven and earth that I desired to learn; and whether it was the outward substance of things, or the inner spirit of nature and the mysterious soul of man that occupied me, still my enquiries were directed to the metaphysical, or, in its highest sense, the physical secrets of the world.[18]

From his childhood Frankenstein viewed nature as Davy said civilized men should--he approached his world with his intellect as well as his senses, he sought nature's inner secrets as well as her outward beauty. When he found answers to his questions, he experienced a great personal joy--a "gladness akin to rapture." Furthermore, he sought more than just a knowledge of nature; he wanted to discover her power and was led in this search to study the alchemists.

> If . . . my father had taken the pains to explain to me, that the principles of Agrippa had been entirely exploded, and that a modern system of science had been introduced, which possessed much greater powers than the ancient, because the powers of the latter were chimerical, while those of the former were real and practical; under such circumstances, I should certainly have thrown Agrippa aside . . .[19]

Davy had said that the scientist should control nature, not just understand it. Frankenstein agreed with this feeling, and, again, in his youth, he was drawn toward the alchemists.

> The untaught peasant beheld the elements around him, and was acquainted with their practical uses. The most learned philosopher knew little more. He had partially unveiled the face of Nature, but her immortal lineaments were still a wonder and a mystery. . . .
> But here were books, and here were men who had penetrated deeper and knew more. I took their word for all that they averred, and I became their disciple. . . . Under the guidance of my new preceptors, I entered with the greatest diligence into the search of the philosopher's stone and the elixer of life; but the latter soon obtained my undivided attention. . . . what glory would attend the discovery, if I could banish disease from the human frame, and render man invulnerable to any but a violent death![20]

Frankenstein had discovered in the alchemists the promise of power, but he found no substance. His first experience with nature's real power caused him to lose faith in the alchemical philosophy and, for a time, in science. During a thunder storm, Frankenstein saw a bolt of lightning utterly demolish a tree behind his house. A natural philosopher visiting his family explained the phenomena of electricity and galvanism to him, and Frankenstein became disillusioned with the alchemists' promises, so shaded by the light of truth, and began to study mathematics instead.

> All that he said threw greatly into the shade Cornelius Agrippa, Albertus Magnus, and Paracelsus, the lords of my imagination; but by some fatality the overthrow of these men disinclined me to pursue my accustomed studies. It seemed to me as if nothing would or could ever be known.[21]

Frankenstein's early experiences represent one scientist's attempts to define his intellectual goals. On another level, the events of his youth reflect the historical rise of the study of chemistry. Man began with a general desire to find explanations for natural phenomena. This developed into a desire to control nature. But the first men to seek the power hidden in nature were "visionaries" and sought imaginary powers rather than real ones. The scientist distrusted this approach and turned to mathematics, so the scientific advances of the seventeenth century were made in astronomy, physics, and mathematics by such men as Galileo, Kepler, Descartes, and Newton, who, if they studied chemistry at all, did not publish their findings. In the eighteenth century men began to study chemistry again, in a serious, scientific way.

Frankenstein's interest in chemistry was revived when he began attending the university at Ingolstadt, where he became acquainted with two scientists. The professor of natural history was M. Krempe, whom Frankenstein described as "a little squat man, with a gruff voice and a repulsive countenance." Krempe was so unattractive in appearance and personality that he was unable to inspire Frankenstein to study his science. Instead, he reinforced Victor's feelings that modern science was useless.

The professor of chemistry, M. Waldman, was a very different sort of man.

> He appeared about fifty years of age, but with an aspect expressive of the greatest benevolence; a few grey hairs covered his temples, but those at the back of his head were nearly black. His person was short, but remarkably erect; and his voice the sweetest I had ever heard.[22]

M. Waldman does have the power to renew Frankenstein's interest in the sciences and inspire him to be the kind of modern scientist Davy described. The conclusion of Waldman's introductory lecture was a "panegyric upon modern chemistry," Frankenstein says, "the terms of which I shall never forget . . ."

> "The ancient teachers of this science . . . promised impossibilities, and performed nothing. The modern masters promise very little; they know that metals cannot be transmuted, and that the elixir of life is a chimera. But these philosophers, whose hands seem only made to dabble in dirt, and their eyes to pore over the microscope or crucible, have indeed performed miracles. They penetrate into the recesses of nature, and show how she works in her hiding places. They ascend into the heavens: they have discovered how the blood circulates, and the nature of the air we breathe. They have acquired new and almost unlimited powers; they can command the thunders of heaven, mimic the earthquake, and even mock the invisible world with its own shadows."[23]

This speech rather clearly echoes one of the more moving passages from Davy's "Discourse."

> The dim and uncertain twilight of discovery . . . has been succeeded by the steady light of truth . . . The composition of the atmosphere, and the properties of the gases, have been ascertained; the phaenomena of

> electricity have been developed; the lightnings have been taken from the clouds; and lastly, a new influence has been discovered, which has enabled man to produce from combinations of dead matter effects which were formerly occasioned only by animal organs.[24]

Both Davy and M. Waldman were discussing the power man had acquired through the study of the sciences. Both felt that this power was admirable, that it was good for men to gain powers through science. It is interesting to note that the power Davy mentions last, the "new influence . . . which has enabled man to produce from combinations of dead matter effects which were formerly occasioned only by animal organs," is not mentioned by Waldman. It is this power, however, that Victor Frankenstein discovers and uses to create his monster.

M. Waldman's speech caused Frankenstein's desire for power, first whetted by his reading of the alchemists, to be revived. This time, however, the power he sought was real.

> . . . my mind was filled with one thought, one conception, one purpose. So much has been done, exclaimed the soul of Frankenstein,--more far more, will I achieve: treading in the steps already marked, I will pioneer a new way, explore unknown powers, and unfold to the world the deepest mysteries of creation.[25]

Again, Frankenstein echoes Davy: "Science has done much for man, but it is capable of doing still more . . ."[26]

Frankenstein has come to believe in progress. He feels new knowledge and new powers can be found, and he has been inspired to join in the search for them.

His early interest in the elixir of life helps to direct Frankenstein's efforts toward a search for the life force. He soon becomes what Davy would have considered to be an almost perfect scientist. He begins by realizing that, in order to succeed in chemistry, he must study the other sciences as well. M. Waldman advises him:

> Chemistry is that branch of natural philosophy in which the greatest improvements have been and may be made: it is on that account that I have made it my peculiar study; but at the same time I have not neglected the other branches of science. A man would make but a very sorry chemist if he attended to that department of human knowledge alone. If your wish is to become really a man of science, and not merely a petty experimentalist, I should advise you to apply to every branch of natural philosophy . . .[27]

just as Davy had said that the scientist who wished to follow "extensive views" would need to know mechanics, chemistry, and physics. In two years, Frankenstein learns all the professors at Ingolstadt can teach him about natural history, anatomy, and physiology.

In the "Discourse," Davy mentioned another reason for the failure of some scientists' studies. Sometimes, he said, a man will try to uncover truth too quickly. "Instead of slowly endeavouring to lift up the veil concealing the wonderful phaenomena of living nature; full of ardent imaginations, they have vainly and presumptuously attempted to tear it asunder."[28] Frankenstein, however, is not guilty of this flaw. His work is neither magical nor visionary; he comes upon his discovery slowly and methodically. "Some miracle might have produced it," he said, "yet the stages of the discovery were distinct and probable." He continues:

> Not that, like a magic scene, it all opened upon me at once: the information I had obtained was of a nature rather to direct my endeavours so soon as I should point them towards the object of my search, than to exhibit that object already accomplished.[29]

So, Frankenstein is following the advice not only of Davy but also of Bacon and other scientists who said that the greatest truths in science would be discovered by a slow process which would lead from small discoveries to larger ones.

Frankenstein succeeded where others had failed because he was "slowly endeavouring to lift up the veil." Behind it, he discovered the light of knowledge shining through the darkness of ignorance to a degree that exceeded even Davy's expectations. For rather than Davy's "steady light of truth" which shines through the "uncertain twilight of discovery," Frankenstein discovered

> from the midst of this darkness . . . a light so brilliant and wondrous, yet so simple, that while I became dizzy with the immensity of the prospect which it illustrated, I was surprised, that among so many men of genius who had directed their enquiries toward the same science, that I alone should be reserved to discover so astonishing a secret.[30]

The Gothic tone which surrounds Frankenstein's discovery often obscures the fact that he was working within an established scientific field, chemical physiology. He indicated that he was one of many men who were trying to discover the life force; what seemed miraculous to him was that he was the one who succeeded. Davy's "Discourse" illustrates that Frankenstein was being no more scientifically presumptuous than many of the scientists of the age. Davy believed that the "mysterious and complicated powers of life" could be discovered through chemical experimentation. He was particularly interested in the effects of galvanism on animal tissues.[31] When he refers to the "new influence" which "has enabled man to produce from . . . dead matter effects which were formerly occasioned only by animal organs," he is thinking of the work begun by Luigi Galvani in the 1780's. Galvani noticed that dead muscle tissue would contract when exposed to an electrical force, and he formulated a theory that animals possess the equivalent to an electric current in their nerves and muscles.[32]

Davy, who was an advocate of galvanic chemistry, felt that this experimentation would eventually lead to the discovery of the life force. In his "Syllabus of a Course of Lectures on Chemistry," published with the "Discourse Introductory" in 1802, he said:

> The well known facts relating to the torpedo, electrical eel, etc. prove that galvanic electricity is capable of being excited by the agencies of living organs. These facts, compared with the phaenomena of the production of muscular contractions by galvanism, lead to interesting inquiries concerning the relation of this influence to living action. The general connection of electricity with physiology and with chemistry, which is at present involved in obscurity, is probably capable of experimental elucidation; and the knowledge of it would evidently lead to novel views of the philosophy of the imponderable substances.[33]

Elsewhere, Davy indicated that he believed the life force to be a chemical force similar to but more powerful than heat and electricity. At the conclusion of a passage discussing the chemical changes involved in animal functions, he said:

> The principles of animal matter are much more numerous, and more complicated in cheir arrangements, than those of vegetable matter. In irritable and sensitive action, the laws of chemistry are submitted to the powers of life, and their distinct and peculiar operation is seldom or never perceived. . . . Heat in the animal body is constantly regulated by the living functions; and thus an agent, most powerful in modifying common matter, as well as electricity, appears in this case, as the passive instrument of a superior and more active principle.[34]

In his discussion concerning physiological chemistry in the "Discourse," Davy said that man would have to study dead matter in order to discover the powers of life: "the study of the simple and unvarying agencies of dead matter ought surely to precede investigations concerning the mysterious and complicated powers of life."[35] This is, of course, exactly what Frankenstein did. He said:

> To examine the causes of life, we must first have recourse to death. I became acquainted with the science of anatomy: but this was not sufficient; I must also observe the natural decay and corruption of the human body. . . . I was led to examine the cause and progress of this decay, and forced to spend days and nights in vaults and charnel-houses. . . .I paused, examining and analysing all the minutiae of causation, as exemplified in the change from life to death, and death to life . . .[36]

Mary Shelley is intentionally unclear about the life-giving process, but she does hint that it might be related to galvanism. Describing the evening of the monster's birth, Frankenstein says, "I collected the instruments of life around me, that I might infuse a spark of being into the lifeless thing that lay at my feet."[37] In the "Introduction" to the 1831 edition of Frankenstein, Mary Shelley directly mentions the galvanic process. "Perhaps a corpse would be re-animated; galvanism had given token of such things: perhaps the component parts of a creature might be manufactured, brought together, and endued with vital warmth."[38]

In the "Preface" to the 1818 edition of Frankenstein, Shelley mentioned the work of Erasmus Darwin, who had also suggested that the life force might be a power like electricity. In the "Temple of Nature," Darwin describes his vision of the original creation of life.

> First Heat from chemic dissolution springs,
> And gives to matter its eccentric wings;
> With strong Repulsion parts the exploding mass,
> Melts into lymph, or kindles into gas.
> Attraction next, as earth or air subsides,
> The ponderous atoms from the light divides,
> Approaching parts with quick embrace combines,
> Swells into spheres, and lengthens into lines.
> Last, as fine goads the gluten-threads excite,
> Cords grapple cords, and webs with webs unite;
> And quick Contraction with ethereal flame
> Lights into life the fibre-woven frame.---
> Hence without parent by spontaneous birth
> Rise the first specks of animated earth;
> From Nature's womb the plant or insect swims,
> And buds or breathes, with microscopic limbs.[39]

Frankenstein's investigations, then, were related to some of the new, exciting scientific theories of the early nineteenth century. To my knowledge, no one had suggested that the life force, once it was discovered, should be used to create a new species of menlike creatures. But, because of their belief in progress, Mary Shelley is suggesting, scientists would eventually be compelled to try to create new forms of life with their new-found power. This would occur not because they would act rashly, but because they would act like rational scientists. Frankenstein proceeded in his studies with caution and conscience. Once he discovered the life force, he considered carefully how he should use his knowledge. "When I found so astonishing a power placed within my hands," he said, "I hesitated a long time concerning the manner in which I should employ it."[40] He decided that he could succeed in making a living creature and that, if he in any way failed, other scientists who followed him would perfect his invention. The idea that one must create something, even if it must be perfected by others, is fundamental to a doctrine of progress. We have seen, in chapter four, that as people began to believe in progress, they also came to accept the idea that a scientist could fail and still advance knowledge. Throughout Davy's "Discourse" runs the same theme--progress occurs because one generation of scientists struggle to uncover ideas which future generations will perfect.

> [The human mind] has gained new powers and faculties; but it is as yet incapable of using them with readiness and efficacy. Its desires are beyond its abilities; its different parts and organs are not firmly knit together, and they seldom act in perfect unity.[41]

But despite these limitations, man will progress: "the germs of improvement are sown in minds even where they are not perceived, and sooner or later the spring-time of their growth must arrive."[42]

Frankenstein, acting with all the care and consideration that a scientist should have, discovers "the cause of generation and life" and develops that knowledge into the power "of bestowing animation upon lifeless matter." So, as a scientist, he has gained knowledge and power. Davy had suggested that there were other benefits to be gained from science, and Frankenstein also expects to gain personal happiness and satisfaction from his studies. Davy said, for example, that the study of science, because it was always changing and never completed, provided continual intellectual pleasure for men. While working on his project, Frankenstein experienced this feeling.

> None but those who have experienced them can conceive of the enticements of science. In other studies you go as far as others have gone before you, and there is nothing more to know; but in a scientific pursuit there is continual food for discovery and wonder.[43]

Davy also said that science provided a beauty and excitement closely related to hope. In the midst of his studies, Frankenstein also experienced this feeling.

> No one can conceive the variety of feelings which bore me onwards, like a hurricane, in the first enthusiasm of success. Life and death appeared to me ideal bounds, which I should first break through, and pour a torrent of light into our dark world. A new species would bless me as its creator and source; many happy and excellent

> natures would owe their being to me. No father could claim the gratitude of his child so completely as I should deserve theirs. Pursuing these reflections, I thought, that if I could bestow animation upon lifeless matter, I might in process of time (although I now found it impossible) renew life where death had apparently devoted the body to corruption.[44]

So, Frankenstein felt the excitement of success mixed with a desire to continue a work which he believed would improve society. He expected his creature to be good and to thus add to the world "many happy and excellent natures." He also hoped to someday be able to give the world a "cure" for death. Frankenstein discovered, however, that though his science, compared to that of the alchemists, was all too real, the benefits of that science were chimerical.

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Frankenstein's remarkable scientific achievement did not benefit society. His creature became a social menace, dedicated to the destruction of human beings. A new force had been introduced into society, but even the best people presented in the book did not use the force correctly. In fact, even the creator of the power of life was not capable of maturely handling his creation. It is quite clear that the new creature began as a force more inclined toward good than evil. But, after he was rejected first by his creator and then by the people he tried to help, he turned against society and became as destructive as he had been potentially good. Frankenstein's scientific invention did not improve society; rather, society determined whether the amoral creation would bring good or evil into the world.

Frankenstein's studies proved detrimental both to society and to himself, the individual scientist. Davy had suggested that advances in science would help increase community between human beings. But Frankenstein's studies isolated him. While he was working on the creature, he found he could not communicate with his family and friends. Even though he realized that his silence was worrying his father, he could not disengage himself from his work long enough to write letters to him. As the story continued, Frankenstein's isolation became more and more complete. In order to escape his feelings of despair, he sought solitude: "solitude was my only consolation," he said, "deep dark, deathlike solitude."[45] As his emotions isolated him figuratively, his scientific creation isolated him literally by annihilating his family and friends. By the end of the story he is completely alone, following his daemon around the world, seeking to destroy what he had once worked so hard to create. By the end of his life, he is incapable of accepting a friendship which could break his isolation. When Captain Walton, the man who rescues Frankenstein from a floating patch of ice, speaks of his desire to have a friend, Frankenstein answers,

> we are unfashioned creatures, but half made up, if one wiser, better, dearer than ourselves--such a friend ought to be--do not lend his aid to perfectionate our weak and faulty natures. . . . But I--

> I have lost every thing, and cannot begin life anew.[46]

Isolated from society, Frankenstein has lost the ephemeral hope that he had grasped from science.

Frankenstein's scientific studies isolated him not only from society but also from the nature whose secrets he desired to uncover. During the time he was creating the monster, he cut himself off from his natural surroundings.

> The summer months passed while I was thus engaged, heart and soul, in one pursuit. It was a most beautiful season; never did the fields bestow a more plentiful harvest, or the vines yield a more luxuriant vintage; but my eyes were insensible to the charms of nature.[47]

Seeking life and beauty, Frankenstein removed himself from nature, the source of these things, and entered a world of death and corruption, vaults and charnel-houses.

After the string of catastrophes which follow the monster's creation has begun, Frankenstein finds that the joy he once received from nature too often eludes him.

> Thus not the tenderness of friendship, nor the beauty of earth, nor of heaven, could redeem my soul from woe: the very accents of love were ineffectual. I was encompassed by a cloud which no beneficial influence could penetrate.[48]

The light of scientific discovery which had flashed through the darkness of Frankenstein's ignorance had indeed been like a bolt of lightning--it had illuminated his mind for a moment and brought him hope and happiness, but after that moment the darkness had returned. Furthermore, for Frankenstein, the power of science was destructive. The "spark" which brought the monster to life soon became the lightning bolt which would destroy Frankenstein, who became a human analogue to the tree he had seen blasted by lightning. As he observed:

> But I am a blasted tree; the bolt has entered my soul; and I felt then that I should survive to exhibit, what I shall soon cease to be--a miserable spectacle of wrecked humanity, pitiable to others, and intolerable to myself.[49]

Using the same image in a later passage, Mary Shelley relates the lightning bolt to the monster--the force Frankenstein had created. When Frankenstein finally refuses to create a mate for the monster, his creation tells him, "soon the bolt will fall which must ravish from you your happiness."[50] He is referring to the revenge he has planned--to kill Frankenstein's bride on their wedding night just as Frankenstein has killed his bride by refusing to complete the female of the new species. Again, the force, when it is not used correctly, becomes an agent for destruction.

The lightning image is carried one step farther, however, for Frankenstein is not the only being destroyed by the symbolic bolt. The monster says that Frankenstein can "blast" his other passions but cannot destroy his desire for revenge. The destruction of the monster's soul was also caused by the terrible isolating effect of science. Frankenstein, as a result of his study, becomes cut off from science itself and thus from his creation. When he finishes his project, Frankenstein cannot stand to look at his creature; he cannot tolerate seeing his instruments or discussing science. When the monster forces him to return to his studies, they are a constant torment to him, and he cannot finish the work he begins. He has lost the pleasure he received from his studies, his hope of improving the world, his power to create. As a result, he loses control of the power he has already created, and the creation becomes master of the creator. "You are my creator," the monster tells him, "but I am your master . . ."[51]

At last, Frankenstein himself becomes a monster. Both Frankenstein and his creation are isolated from mankind, have lost all hope of happiness, and live only for revenge. Each of them spends the last moments of his life trying rather unsuccessfully to rationalize the inhuman actions his isolation has caused him to perform. But their remorse and their excuses seem empty because they are born from selfishness rather than from the sense of community.

Frankenstein admits that he did not fulfill his obligation to his creation but claims he is more answerable to the members of his own species than to a monster. He feels that in destroying the monster's wife he acted nobly and regrets only that he was not able to destroy the monster also.[52] The reader, however, who believes that the creature was once as noble and trustworthy as Frankenstein, realizes that this distinction between an obligation to man and to scientific creation is false. Frankenstein's duty to society includes his responsibility to his creation--his feeling of obligation for one does not alter his duty to the other.

At the end of the book, soon after Frankenstein dies, the monster appears to tell his sad tale. Once again, the reader cannot totally accept his excuses for his bad behavior. He tells Walton that killing Frankenstein's friends made him feel wretched--that he never really enjoyed being evil--but that he was driven on by "a frightful selfishness" while his heart "was poisoned with remorse."[53] He feels he should be pitied, for society has irreparably damaged him. Others' villainy turned him into a villain; others' hate caused him to hate both them and himself. Never has the monster seemed less noble than in this passage where he tries so hard to prove that he is. In the end, then, the creator and the creation mirror each other. Their outward appearances are different, but their souls are the same. Science has led to the ruin of both.

Frankenstein's experience, from the moment when he becomes inspired to create the monster to the moment when, almost a monster himself, he dies, demonstrates that Davy's belief that science will improve the world is not necessarily true. But the novel does not suggest that science is always dangerous or that scientific ambition is always wrong. By creating the character of Robert Walton, the explorer to whom Frankenstein tells his story, Mary Shelley is able to present an alternative. Walton is a dedicated scientist, but he is also a humanist. In many ways he is like Frankenstein, but he is also like Frankenstein's friend and opposite, Henry Clerval.

Frankenstein's account of his early life makes it quite clear that his impulses were always scientific. His friend Clerval, however, was interested in poetry, in government, in the "moral relations of things." While Victor sought the secrets of nature, Clerval grew to love romance.

> /Clerval/ loved enterprise, hardship, and even danger, for its own sake. He was deeply read in books of chivalry and romance. He composed heroic songs, and began to write many a tale of enchantment and knightly adventure. He tried to make us act plays, and to enter into masquerades, in which the characters were drawn from the heroes of Roncesvalles, of the Round Table of King Arthur, and the chivalrous train who shed their blood to redeem the holy sepulchre from the hands of the infidels.[54]

Clerval's love for romance developed into an interest in man as a social and moral rather than as a physiological being.

> Meanwhile, Clerval occupied himself, so to speak, with the moral relations of things. The busy stage of life, the virtues of heroes, and the actions of men, were his theme; and his hope and his dream was to become one among those whose names are recorded in story, as the gallant and adventurous benefactors of our species.[55]

Both Frankenstein and Clerval wished to help mankind, but they chose different means by which to try to accomplish their goals.

Clerval's interests, which he pursued with the same ardent dedication which Frankenstein had for chemistry, served to increase his communication with other men rather than isolate him from them. He maintained a lasting love and friendship for Frankenstein and his family while he followed studies which were to prepare him to go to India to assist "the progress of European colonisation and trade."[56] Clerval, then, was fully committed to individual men and to society, though he did not study science.

Robert Walton resembles both Frankenstein and Clerval. Like Frankenstein, he seeks both knowledge and power. His goal is to discover the North Pole, where he can make celestial observations which will help complete astronomical theory, where he may "discover the wondrous power which attracts the needle," a power some people felt would prove more useful than electrical power,[57] and where he hopes to discover "a passage near the pole to those countries, to reach which at present so many months are requisite."[58] He has undertaken this project, he says, because of "the inestimable benefit which . . . [he will] confer on all mankind to the last generation," because of the "joy" it will give him to "satiate [his] ardent curiosity with the sight of a part of the world never before visited," and because he "preferred glory to every enticement that wealth placed in [his] path."[59] Like Frankenstein, Walton believed the philosophy of Davy and other scientists who said that the study of science could yield individual happiness and benefits for mankind.

Walton's education, also, was similar to Frankenstein's. He had an early passion for reading sea voyages, as Frankenstein had, as a boy, been fascinated by the alchemists. His attention was diverted for a time by other interests, in his case poetry, but he later returned with renewed vigor to his earlier studies and devoted himself to them completely.

> Six years have passed since I resolved on my present undertaking. I can, even now, remember the hour from which I dedicated myself to this great enterprise. I commenced by inuring my body to hardship . . . . I voluntarily endured cold, famine, thirst, and want of sleep . . .[60]

Just as Frankenstein, following M. Waldman's advice (and the advice of Davy), studied various disciplines to achieve the greatest scientific understanding possible, so Walton studied a number of sciences.

> I . . . devoted my nights to the study of mathematics, the theory of medicine, and those branches of physical science from which a naval adventurer might derive the greatest practical advantage.[61]

Walton, like Frankenstein, is a dedicated scientist. However, in several important ways, he is also like Clerval, the humanist. He had been entranced, as Clerval had, by language and poetry, and though he failed to become a poet, he was influenced by his study of literature. As he writes to his sister:

> I am going to unexplored regions, to 'the land of mist and snow;' but I shall kill no albatross, therefore do not be alarmed for my safety, or if I should come back to you as worn and woful as the 'Ancient Mariner?' You will smile at my allusion; but I will disclose a secret.

> I have often attributed my attachment to, my passionate enthusiasm for, the dangerous mysteries of ocean, to that production of the most imaginative of modern poets. There is something at work in my soul, which I do not understand. I am practically industrious--pains-taking;--a workman to execute with perserverance and labour:--but besides this, there is a love for the marvellous, a belief in the marvellous, intertwined in all my projects, which hurries me out of the common pathways of men, even to the wild sea and unvisited regions I am about to explore.[62]

So, Walton himself realizes that he contains both a love for science and a love for poetry and that each is influencing his life.

Like Clerval, Walton values friendship highly. He refuses to become isolated by his scientific studies, even though his search for the pole takes him far away from his family and friends. Frankenstein could not write to his father while he was studying, but Walton, even though he is working almost all the time, communicates with his sister as often as he can. But written communication alone does not completely satisfy him; he feels he needs a friend.

> But I have one want which I have never yet been able to satisfy; and the absence of the object of which I now feel as a most severe evil. I have no friend, Margaret: when I am glowing with the enthusiasm of success, there will be none to participate my joy; if I am assailed by disappointment, no one will endeavour to sustain me in dejection. . . . How would such a friend repair the faults of your poor brother! . . . I greatly need a friend who would have sense enough not to despise me as romantic, and affection enough for me to endeavour to regulate my mind.[63]

Davy had suggested, again along with others, that the study of science could make a man good. Through Walton, Mary Shelley says that it is fellowship between men that helps "repair the faults" of men.

When Frankenstein appears, Walton is immediately attracted to him and soon "begin/s/ to love him as a brother."[64] Even though Frankenstein is unable to completely return his friendship, Walton becomes as dedicated to Frankenstein as Clerval had been. He spends all his spare moments caring for Frankenstein, whose health is broken, and recording his fantastic story.

Frankenstein was a complete scientist, but Walton, who is scientist and humanist, is a complete man, and he is thus able to make decisions Frankenstein could not make. Though Frankenstein is continually warning Walton of the dangers of scientific inquiry, he himself remains dedicated to science to the end. Though he refuses to tell Walton how to generate life, and though he claims time after time that he wishes he had remained blissfully ignorant, his final words reveal that he still believes in science.

> Fairwell, Walton! Seek happiness in tranquillity, and avoid ambition, even if it be only the apparently innocent one of distinguishing yourself in science and discoveries. Yet why do I say this? I have myself been blasted in these hopes, yet another may succeed.[65]

Furthermore, it is Frankenstein who urges Walton's crew to continue their voyage when, faced with the continual threat of death, they are ready to mutiny. He tells the men:

> What do you mean? What do you demand of your captain? Are you then so easily turned from your design? Did you not call this a glorious expedition? And wherefore was it glorious? Not because the way was smooth and placid as a southern sea, but because

> it was full of dangers and terror; because, at every new incident, your fortitude was to be called forth, and your courage exhibited; because danger and death surrounded it, and these you were to brave and overcome. . . . You were hereafter to be hailed as the benefactors of your species; your names adored, as belonging to brave men who encountered death for honour, and the benefit of mankind.[66]

Frankenstein, who had recently told Walton, "Do you share my madness? Have you drank also of the intoxicating draught? Hear me,--let me reveal my tale, and you will dash the cup from your lips!"[67] is still compelled to stand up for the science which he says has been his enemy and destroyed him.

Walton himself, however, cannot say these things to his men. Even though, at the beginning of the novel, he told Frankenstein, "I would sacrifice my fortune, my existence, my every hope, to the furtherance of my enterprise. One man's life or death were but a small price to pay for the acquirement of the knowledge which I sought; for the dominion I should acquire and transmit over the elemental foes of our race,"[68] Walton cannot really act on that principle, for his social sense is too strong. Forced to decide between human life and science, he chooses the lives of his men. He tells his sister, "the men, unsupported by ideas of glory and honour, can never willingly continue to endure their present hardships."[69] He does not choose to go against the will of his companions, even though he says, "I had rather die than return shamefully,--my purpose unfulfilled."[70] Walton is terribly disappointed that he must return home. "It requires more philosophy than I possess," he says, "to bear this injustice with patience."[71] But, in fact, it is not philosophy that he turns to for consolation. Because Walton is not isolated, he finds the comfort he needs by thinking of his return to his sister. "While I am wafted toward England, and toward you," he tells her, "I will not despond."[72]

As a complete man, Walton accomplishes one other thing in the novel. He is the only character to communicate with the monster and feel something for him, even though by the end of the novel, the creature is an almost complete fiend with few of the noble qualities he once possessed. When Walton first sees the monster he is as shocked by his hideous appearance as everyone else has been. "Never did I behold a vision so horrible as his face, of such loathsome yet appalling hideousness,"[73] he says. But instead of fleeing or attacking the creature, he tells us, "I shut my eyes involuntarily, and endeavoured to recollect what were my duties with regard to this destroyer. I called on him to stay."[74] He is the first man in the book to seriously consider his obligation to the creature science had created. As he listens to the monster alternately weep and rage over the body of its creator, Walton finds he cannot follow Frankenstein's instructions to kill it, for he is filled with "a mixture of curiosity and compassion."[75]

Perhaps at one time in the creature's life Walton could have helped it, but the monster can no longer accept human assistance or compassion, just as Frankenstein, because he had been isolated so long, could no longer accept friendship. "I seek not a fellow-feeling in my misery," the monster tells Walton. "No sympathy may I ever find. . . . I am content to suffer alone, while my sufferings shall endure . . ."[76]

Since Frankenstein is dead and the creature no longer needs to seek revenge, he is content to destroy himself and make his isolation complete.

Though Walton's scientific project was not successful, he was a success, in Mary Shelley's eyes, because he was a complete man. Isolation caused both Frankenstein and the daemon to become monsters. His ability to overcome isolation caused Walton to be able to make a decision that helped mankind, though it hurt science. He was able to be both man and scientist--something not "monstrous" in Mary Shelley's eyes. A third monster in the novel, also born of isolation, is science itself. When it becomes isolated from other human concerns, when it becomes the total endeavor of a man, or a society of men, to the exclusion of social and moral commitments, science becomes a monster, capable of introducing forces into the world that men can neither understand nor control. The complete man who follows science may work more slowly and fail more often than the man completely obsessed with his studies, but he will have the power of human kindness available to help him control the natural powers he discovers.

Davy realized that men might use the powers of science wrongly, but he simply wasn't very worried about the problem.

> Individuals, in consequence of interested motives or false views, may check for a time the progress of knowledge; moral causes may produce a momentary slumber of the public spirit; the adoption of wild and dangerous theories, by ambitious or deluded men, may throw a temporary opprobrium on literature; but the influence of true philosophy will never be despised . . .[77]

Davy believed that the course of science might cause a little destruction, but eventually, he said, a better world would arise from the seeds of science that fell on fruitful ground. From these seeds, he foresaw, would arise new powers for men and a new age of social peace and human concern between men. Mary Shelley, however, was skeptical. She saw nothing in science with the power to form human relationships. To her, it was the poetic imagination that sparked humanistic concerns, not the scientific one. The love for mankind needed to control science, she felt, must be generated in all men before scientific powers could be more useful than they were dangerous.

Davy had promised his London audience that "society should be ultimately connected together by means of knowledge and the useful arts" so that men would begin to act as the children of "one great parent." One feels, reading Davy, that this parent, who gives the gifts of "dignity," "power," "consolation," "happiness," "reverence," "tranquility," and "order" to her children, must be science. But a parent can pass on to a child only those qualities she possesses. "Chemistry," Davy had said, "is that part of natural philosophy which rela to those intimate actions of bodies upon each other, by which their appearances are altered, and their individuality destroyed." Perhaps Mary Shelley is suggesting that man really does inherit characteristics from that which he passionately studies. If he studies romances, he becomes heroic, noble, a social and moral creature. If he studies chemistry, as Frankenstein did, he, like the elements in his chemical reactions, loses his individuality and becomes something different from a man--a new, monstrous creature.

In 1802 Humphrey Davy, following the example of many advocates of the new science, published his ideas concerning the beneficial powers of the experimental scientist. He pictured first the scientist--a man whose studies covered a broad range of scientific concerns, a man who sought for himself and mankind new knowledge that would lead to new power and who succeeded in finding not only this, but beauty, hope, and inner peace as well. He then envisioned a society which, filled with scientific concern, abandoned the love for political and social power that separates men and united in the search for natural powers which can be used equally by all. The dawn of the time of peace and prosperity for all men, Davy said, is upon the world. The light which will overcome the darkness is science. Mary Shelley, following the example of many writers who came before her, created an alternative to this vision, in order to question the relationship between science and man. She presented a fictional picture of a perfect scientist, working for the benefit of mankind within a scientific field that Davy and other scientists of the age considered very exciting and promising. She allowed her character to experience great scientific success, to discover the power of life, and then she envisioned what would happen if such a power were really loosed in society. Scientific study, she concluded, does create powers, but it does not create men or societies capable of using power wisely. Nor can it, isolated from real humanistic concerns, bring a lasting happiness to the individuals who dedicate themselves to the scientific cause. The power of science, she decided, is useful only when it is controlled and tempered by other, more important powers. The force of brotherly love, which can overcome human isolation, gained from a study, not of science, but of poetry or romance--the real sources of beauty--can control the power of science. If men can, like Captain Walton, be both poets and scientists, then science can become a useful tool for mankind. The uncontrolled power of science, however, like the bolt of lightning, will blast mankind. Beautiful and sublime for an instant, its powers are magnificent; but it leaves behind it not the dawn of a new age, but destruction and desolation.

CONCLUSION

In the seventeenth and eighteenth centuries, while scientists were investigating new natural phenomena, numerous writers were considering the implications of a new social phenomenon--the experimental scientist. Those who watched the emergence of this new social creature often attempted, with some difficulty, to classify or define him. The seventeenth century writers who first viewed the new scientist determined that his most distinguishing feature was his wonderful dreams. Francis Godwin was willing to accept the scientist's vision as something unique and potentially useful, but other writers decided to consider him as a glorified alchemist (another great dreamer) and thus to find a place for him in the existing social order.

During the eighteenth century, as the scientist began to influence society, interest in his dreams was augmented by interest in his power. Again, the writers attempted to correlate the forces of science with other, already existing social forces. Those who viewed the scientist as projector attributed his power to money and politics. Those who looked with favor on the new social creature associated his power with moral force and the power of God. By the end of the eighteenth century, the scientist had been called many names and had been viewed as both hero and fool, but he had not been given a literary definition of his own.

In Frankenstein, Mary Shelley provides an explanation for the scientist that distinguishes his character from others. He is neither a politician nor a moralist--his power comes neither from men nor from God. He is a man who has discovered how to use the powers of nature, but, being fallible, he does not always use them wisely. He is a creator, not of beauty, but of forces that can be beautiful or ugly, depending on the humaneness of those who use them. In short, he is a man who has the power to innocently create destruction and so must learn, painfully, to be responsible for his creation. In fiction, as in society, he was a new phenomenon--a character who had not existed before with a power that could not be classified with any other social force.

Mary Shelley analyzed the character of the scientist by testing his dreams. In doing so, she helped to begin a tradition of fiction whose purpose is to imaginatively project men into a future where their visions are not doubted, as were the visions of the virtuosos and the projectors, but tested, to see where, behind the dream, a nightmare might be hiding. The scientist's dreams, coupled with his power, change society, just as Francis Bacon and those who followed him promised that they would. The power to change, however, as Mary Shelley demonstrated, is frightful when it is not accompanied by the imaginative power to envision the outcome of change. The writer of science fiction, in a world where the scientist is a very real and a very accepted part of society, removes the scientist and his discoveries from the isolation of the laboratory and places them in a world where not all causes and effects are predictable, where not all truth leads to beauty, and where not all visions become dreams come true. He thus adds to the truth of science the insights of imagination that provide paths toward a more complete vision of the future.

NOTES

Introduction

[1]Brian W. Aldiss, Billion Year Spree: The True History of Science Fiction (Garden City, New York: Doubleday, 1973), pp. 15-20.

[2]Aldiss, pp. 12-18.

[3]For example, Marjorie Hope Nicolson investigates the evolution of the idea of space travel in Voyages to the Moon (New York: Macmillan, 1960), Robert Philmus traces both scientific ideas and mythical patterns in Into the Unknown: The Evolution of Science Fiction from Francis Godwin to H.G. Wells (Berkeley and Los Angeles: The University of California Press, 1970), and Aldiss devotes his pre-Frankenstein chapter to a discussion of moon voyages and utopias.

[4]Charles Richard Weld, A History of the Royal Society (London: John W. Parker, 1848), I, 465.

[5]Weld, I, 508-9.

[6]Weld, I, 506-7.

[7]A. Wolf, A History of Science, Technology, and Philosophy in the 18th Century, 2nd ed., rev. D. McKie (New York: Harper, 1961), II, 578.

[8]Wolf, II, 588-98.

[9]Wolf, II, 618-24.

[10]Thomas Thomson, History of the Royal Society, from Its Institution to the End of the Eighteenth Century (London: Printed for Robert Baldwin, 1812), pp. 429,458.

Chapter I notes to pp. 8-12

[1]Patrick Moore, for example, in *Science and Fiction* (London: George G. Harrap & Co., 1970), defines science fiction as "any story with a scientific background," (p. 10) and begins his discussion with ancient myths. Philmus, in *Into the Unknown*, says, "science fiction differs from other kinds of fantasy by virtue of the more or less scientific basis, real or imaginary, theoretical or technological, on which the writer predicates a fantastic state of affairs," (p. 2) and begins his discussion with Godwin's *Man in the Moone*. Aldiss, in *Billion Year Spree*, defines science fiction as "the search for a definition of man and his status in the universe which will stand in our advanced but confused state of knowledge (science), and is characteristically cast in the Gothic or post-Gothic mould," (p. 8) and claims *Frankenstein* to be the first representative of the genre.

[2]See Nicolson, pp. 14-15 and 41-47, Aldiss, chapter three, and Philmus, chapter two.

[3]Richard Foster Jones, *Ancients and Moderns: A Study of the Rise of the Scientific Movement in Seventeenth-Century England*, 2nd ed., rev. (St. Louis: Washington University Studies, 1961), p. 4.

[4]Jones, p. 5.

[5]Sir Thomas Elyot, *The Boke Named the Governour* (London: J. M. Dent, and New York: E. P. Dutton and Co., n.d.), pp. 35-41.

[6]Elyot, p. 43.

[7]Francis Bacon, *Novum Organum Scientiarum: A New Machine for Rebuilding the Sciences*, in *The Philosophical Works of Francis Bacon*, ed. Peter Shaw (London: Printed for J. J Knapton, et al., 1733), II, 339.

[8]Aristotle, *Analytica Posteriori*, trans. G. R. G. Mure, in *The Works of Aristotle Translated into English*, ed. W. D. Ross, I (Oxford: Oxford University Press, 1928), Book I, sec. 4, 73a.

[9]Aristotle, *Analytica Posteriori,* Book I, sec. 18, 81a-b.

[10]Aristotle, _Analytica Posteriori_, Book II, sec. 19, 100b.

[11]Peter Heylyn, _Cosmography, In Four Books. Containing the Chorography and History of the Whole World, and All the Principal Kingdoms, Provinces, Seas, and Isles thereof_., rev. (London: Printed for Philip Chetwind, 1670), sig. A3.

[12]Bacon, _Novum Organum_, Aphorism 54, p. 356.

[13]Bacon, _Novum Organum_, Aphorism 19, p. 347.

[14]Bacon, _Novum Organum_, Aphorism 9, p. 345.

[15]Bacon, _Novum Organum_, Aphorism 21, p. 347.

[16]Bacon, _Novum Organum_, Aphorism 45, p. 353.

[17]Bacon, _Novum Organum_, Aphorism 47, p. 354.

[18]Bacon, _Novum Organum_, Aphorism 49, p. 354.

[19]Bacon, _Novum Organum_, Aphorism 14, p. 346.

[20]Bacon, _Novum Organum_, Aphorism 10, p. 345.

[21]Bacon, _Novum Organum_, Aphorism 50, p. 355.

[22]Bacon, _Novum Organum_, Aphorism 98, pp. 393-94.

[23]Bacon, _Novum Organum_, Aphorism 100, pp. 394-95.

[24]Bacon, _Novum Organum_, Aphorism 103, p. 396.

[25]Bacon, _Novum Organum_, Aphorism 95, p. 392.

[26]Godfrey Goodman, _The Fall of Man_, quoted in Jones, p. 27.

[27]Bacon, _Novum Organum_, Aphorism 84, p. 381.

[28]Bacon, _Novum Organum_, Aphorism 81, p. 377.

[29]Bacon, *Novum Organum*, Aphorism 90, p. 388.

[30]Elyot, pp. 2-4.

[31]Bacon, *Novum Organum*, Aphorism 89, pp. 386-87.

[32]Bacon, *Novum Organum*, Aphorism 89, p. 387.

[33]Bacon, *Novum Organum*, Aphorism 93, p. 391.

[34]Francis Bacon, *De Augmentis Scientiarum: or, The Arrangement, and General Survey, of Knowledge*, in *The Philosophical Works*, I, 18.

[35]Anthony à Wood, *Athenae Oxonienses*, ed. Philip Bliss (Oxford: Printed for F. C. and J. Rivington, et al., 1815), II, 558.

[36]Harold W. Lawton, "Bishop Godwin's *Man in the Moone*," *Review of English Studies*, 7 (1931), 35.

[37]Lawton, p. 36.

[38]Lawton, p. 37.

[39]Grant McColley, "The Date of Godwin's Domingo Gonsales," *Modern Philology*, 35 (1937), 58. McColley quotes from Bacon's *Sylva sylvarum*.

[40]McColley, pp. 58-59.

[41]Francis Godwin, *The Man in the Moone: or A Discourse of a Voyage thither by Domingo Gonsales, The Speedy Messenger* (1638; facsimile rpt. Menston, Yorkshire, England: Scolar Press Limited, 1971), p. 46.

[42]Bacon, *Sylva sylvarum*, quoted in McColley, p. 57.

[43]Godwin, p. 5.

[44]Godwin, p. 5.

[45]Godwin, pp. 24-25.

[46]Godwin, p. 27.

[47]Godwin, pp. 42-46.

[48]Godwin, pp. 46-47.

[49]Godwin, p. 54.

[50]Godwin, pp. 65-66.

[51]Godwin, pp. 58-59.

[52]Godwin, p. 60.

[53]Godwin, pp. 10-11.

[54]Godwin, p. 2.

[55]Godwin, p. 101.

[56]Godwin, pp. 11-12.

[57]Godwin, "To the Ingenious Reader," sig. A3.

[58]See Cyrano de Bergerac, Savinien, *Voyages to the Moon and the Sun*, trans. Richard Aldington (London: George Routledge & Sons, n.d.), pp. 96 ff. and Thomas D'Urfey, *Wonders in the Sun, or, the Kingdom of the Birds*, Augustan Reprint Society Pub. No. 104 (1964).

Chapter II

[1]Bacon, _Novum Organum_, Aphorism 92, p. 389.

[2]Thomas Sprat, _The History of the Royal Society of London for the Improvement of Natural Knowledge_ (London: Printed by T. R. for J. Martyn, 1667), p. 417.

[3]Robert K. Merton, _Science, Technology and Society in Seventeenth Century England_ (New York: Howard Fertig, 1970), pp. 60-61, 71.

[4]Richard Baxter, _A Christian directory: or, a body of practical divinity and cases of conscience_, quoted in Merton, p. 76.

[5]Merton, pp. 62-65.

[6]Merton, p. 63.

[7]Jones, pp. 87-88.

[8]William Petty, "The Advise of W. P. to Mr. Samuel Hartlib, for the Advancement of some particular Parts of Learning," in _The Harleian Miscellany_ (London: Printed for T. Osborne, 1745), VI, 2.

[9]Francis Bacon, _The New Atlantis; or, A Plan of a Society for the Promotion of Knowledge_, in _The Philosophical Works_, I, 288-300.

[10]Petty, p. 2.

[11]Petty, p. 3.

[12]Bacon, _Novum Organum_, Aphorism 98, p. 394.

[13]Petty, p. 3.

[14]Petty, p. 3.

[15]Petty, p. 3.

[16]Petty, p. 3.

[17]Petty, p. 4.

[18]Petty, p. 4.

[19]Petty, p. 5.

[20]Petty, p. 5.

[21]Petty, p. 2.

[22]Petty, p. 2.

[23]Petty, pp. 1-2.

[24]Margery Purver, The Royal Society: Concept and Creation (Cambridge, Massachusetts: The M.I.T. Press, 1967), pp. 109-110.

[25]Sprat, pp. 18-20.

[26]Letter from Robert Boyle to M. Isaac Marcombes, quoted in Purver, p. 194.

[27]John Aubrey, 'Brief Lives,' chiefly of Contemporaries, set down by John Aubrey, between the Years 1669 and 1696, ed. Andrew Clark (Oxford: At the Clarendon Press, 1898), II, 301.

[28]Sprat, p. 56.

[29]Sprat, pp. 57-58.

[30]For English translations of these charters, see The Record of The Royal Society of London For the Promotion of Natural Knowledge, 4th ed. (London: Printed for the Royal Society by Morrison & Gibb Ltd., Edinburgh, 1940), pp. 226 ff. and 250 ff.

[31]Wood, III, 967.

[32]Purver, p. 110.

[33]E[dward] I[rving] C[arlyle], "Seth Ward," *The Dictionary of National Biography*, (Oxford: Oxford University Press, and London: Humphrey Milford, 1967-68).

[34]Purver, p. 110.

[35]Wood, III, 1029.

[36]H[erbert] R[ix], "Henry Oldenburg," *DNB*.

[37]S[idney] L[ee], "William Brouncker," *DNB*.

[38]John Evelyn, *The Diary of John Evelyn*, ed. E.S. de Beer (Oxford: At the Clarendon Press, 1955), III, 332.

[39]Samuel Pepys, *The Diary of Samuel Pepys*, ed. Henry B. Wheatley (London: George Bell and Sons, 1904), VI, 145.

[40]A[gnus] M[ary] C[lerke], "Sir Robert Murray," *DNB*.

[41]Wood, III, 725-26. The other three men were Sir Paul Neile, William Erskine, and Daniel Colwall. Neile was a Royalist who served as one of the Ushers of the Privy Chamber to Charles II. Erskine was Master of the Charterhouse under Charles. Colwall, who was the treasurer of the Royal Society for many years, was a wealthy Londoner. The contributions of these three men in shaping the affairs of the society, however, are relatively unimportant compared to those of the men mentioned above.

[42]Evelyn, III, 531.

[43]Letter from John Wallis to Robert Boyle, quoted in Purver, p. 70.

[44]Perhaps South's speech was particularly annoying to members of the Royal Society because he had switched from being an active Puritan to being a Royalist after the Restoration. Wood says of him: "when it was visible that monarchy would return, upon the success of Gen. Geo. Monk, he was something at a stand, yet still was accounted a member of the fanatic ordinary; but when his majesty's restoration could not be withstood, then did he from the pulpit exercise his gifts against the presbyterians, as a little before he had done against the independents . . ." (IV, 633-34).

[45]Sprat, pp. 37-38.

[46]Sprat, pp. 53-56.

[47]Sprat, p. 63.

[48]Sprat, p. 82.

[49]Sprat, p. 83.

[50]Sprat, p. 119.

[51]Sprat, p. 110.

[52]Sprat, pp. 110-111.

[53]It is interesting to note that two of these three writers were closely associated with William Cavendish, Duke of Newcastle, a Royalist who had more reason than most men to be anti-Puritan. Margaret Cavendish was, of course, his wife. According to the DNB, she calculated that her husband lost £940,000 as a result of the Civil War. On one occasion she went to England to try to raise money and was refused by a parliamentary committee the share of her husband's estate usually granted to wives. After the Restoration, Cavendish regained some, but by no means all, of his lost estates. He became a patron of Thomas Shadwell, and *The Virtuoso* is dedicated to him. Samuel Butler, though not connected with Cavendish, was also a firm Royalist.

[54]Both Aristotelians and Baconians study in the academy in the Blazing World, and both are satirized. Butler's description of Hudibras's education, his training in Greek, Latin, logic, rhetoric, mathematics, and philosophy associates him with the Aristotelians. Butler objected to the Aristotelians on some of the same grounds Bacon did. He shows them to be argumentative and too dependent on authority. In *The Virtuoso* the character Sir Formal Trifle is used to satirize the old learning, particularly the rhetoric associated with the Aristotelians.

[55]Pepys, VI, 324.

[56]Margaret Cavendish, Duchess of Newcastle, *The Description of A New World Called the Blazing-World* (London: A. Maxwell, 1668), pp. 27-28.

[57]Cavendish, p. 28.

[58]Cavendish, p. 28.

[59]A number of critics have tried to identify the specific members of the Royal Society being satirized in the poem. See Sv. Bruun, "Who's Who in Samuel Butler's 'The Elephant in the Moon,'" _English Studies_, 50 (1969), 381-89, and Marjorie Hope Nicolson's _Pepys' Diary and the New Science_ (Charlottesville: University Press of Virginia, 1965), pp. 143-51.

[60]Samuel Butler, "The Elephant in the Moon," in _Satires and Miscellaneous Poetry and Prose_, ed. René Lamar (Cambridge: At the University Press, 1928), 11. 39-42, p. 4.

[61]Butler, "The Elephant in the Moon," 11. 447-56, p. 14.

[62]Butler, "The Elephant in the Moon," 11. 509-520, pp. 15-16.

[63]Pepys, IV, 203.

[64]Thomas Shadwell, _The Virtuoso_, ed. David Stuart Rhodes and Marjorie Hope Nicolson (Lincoln: University of Nebraska Press, 1966), II.ii.231-36, p. 53.

[65]Thomas Birch, _The History of the Royal Society of London For Improving of Natural Knowledge From Its First Rise_ (London: Printed for A. Millar, 1756), III, 503.

[66]Birch, IV, 386-87.

[67]Birch, IV, 552-53, 558.

[68]Shadwell, III.iii.44-50, p. 70.

[69]Shadwell, IV.iii.208-14, pp. 101-102.

[70]Cavendish, p. 32.

[71]Cavendish, p. 47.

[72] Cavindish, p. 122.

[73] Samuel Butler, Characters and Passages from Note-Books, ed. A. R. Waller (Cambridge: At the University Press, 1908), p. 82.

[74] Butler, "The Elephant in the Moon," ll. 1-6, 11-16, p. 3.

[75] Anon., "In praise of the choice company of Philosophers and Witts who meet on Wednesdays weekly, at Gresham College," in "An Early Satirical Poem on the Royal Society," by F. Sherwood Taylor, Notes and Records of the Royal Society of London, 5 (Oct. 1947), 40.

[76] "In praise of the choice company . . .," p. 43.

[77] Shadwell, II.ii.28-36, pp. 44-45.

[78] Shadwell, V.ii.54-56, p. 112.

[79] Shadwell, V.ii.89-92. p. 113.

[80] Shadwell, II.ii.81-86, pp. 46-47.

[81] Shadwell, V.ii.114-16, p. 114.

[82] Bacon, Novum Organum, Aphorism 70, p. 368.

[83] Sprat, pp. 67-68.

[84] Pepys, IV, 26-27.

[85] Birch, I, 497, note f.

[86] Birch, I, 500, note i.

[87] Birch, II, 131-32.

[88] Birch, II, 344.

[89] Birch, II, 469.

[90]Birch, III, 135.

[91]Birch, III, 309.

[92]Birch, IV, 6.

[93]Birch, IV, 7.

[94]Many of the early experiments of the Royal Society involved poisoning or cutting up dogs. Though most members of the society did not seem to find such experiments aesthetically displeasing, other people certainly might have. If Pepys was a typical member, many fellows of the Royal Society did not understand the experiments performed at the meetings. On March 1, 1664/5, after attending his third Royal Society meeting, Pepys wrote: "Here was very fine discourses and experiments, but I do lacke philosophy enough to understand them, and so cannot remember them." The meeting actually did not involve anything very complicated. They heated sulpher and nitre in the rarifying engine to see if they would burn, a letter from Huygens concerning his efforts to determine longitude was read, Evelyn read a paper on the history of bread-making, and they discussed a new chariot design Colonel Blout was working on (Pepys, IV, 341; Birch, II, 19). The three occasions when the society refused aid in practical projects do not appear to be very significant, but they might have prejudiced some people against the society. In 1663, the society was asked to formally help in the development of William Petty's double-bottomed boat. They decided "that the matter of navigation being a state concern was not proper to be managed by the society," (Birch, I, 249). In 1669, the Navy asked the Royal Society to pull up the wrecked ships on the bottom of the Thames River. The members agreed to serve as consultants, but refused to undertake the project in the name of the society, (Birch, II, 385). Several years later, some Quakers asked the society to encourage manufacturing which would provide jobs for the poor, "To which the Society returned for answer, that their address was more proper to the parliament, the matter not properly lying before the Society," (Birch, III, 417).

[95]Shadwell, V.vi.122-24, p. 139.

[96]Shadwell, II.ii.224-26, p. 52.

[97]Samuel Butler, Hudibras, ed. John Wilders (Oxford: At the Clarendon Press, 1967), ll. 205-18, p. 158.

[98]Shadwell, V.vi.130-33, p. 139.

[99]Wood, III, 722.

[100]Elias Ashmole, Memoirs of the Life of that Learned Antiquary Elias Ashmole, Esq.; Drawn up by himself by way of a Diary (London: Printed for J. Roberts, 1717), p. 17.

[101]Petty, p. 7.

[102]Birch, I, 422-27. Weld cites numerous examples of superstitions believed by society members, but of the experiments they performed in order to test these beliefs, he says, "It was a labour well worthy the men who met avowedly for the investigation and development of truth, to inquire into these superstitions, and patiently and dispassionately to prosecute such experiments as should tend to eradicate them . . .

Let not the reader, therefore, when he smiles, as he assuredly will, at many of the seemingly absurd and ridiculous experiments tried by the Society . . . criticise them as mere folly, or the performances of empirics:--they were necessary to the welfare of science,--as much so as it is important to clear away a rotten foundation, ere a solid superstructure can be reared; and it will be seen, how year after year errors were blotted out, and new facts and truths developed," (I, 93). Weld tends to glamorize almost everything the Royal Society did. His point demonstrates, however, that the early fellows of the society, for legitimately scientific reasons, were performing experiments that other people could have interpreted as being magical or alchemical.

[103]A table showing the average number of ordinary members of the Royal Society per year appears in The Record of The Royal Society, "Appendix VII," p. 567. An account of the history of the publication of the Philosophical Transactions can be found in Thomson, pp. 7-8.

[104]Aphra Behn, The Emperor of the Moon, in The Works of Aphra Behn, ed. Montague Summers, III (London: William Heinemann, and Stratford-on-Avon: A. H. Bullen, 1915), p. 460.

[105]Behn, p. 399.

[106]Wing's Short Title Catalogue lists a 1680 English Edition of The Count of Gabalis by [Montfaucon de Villars].

[107]Behn, p. 461.

[108]Collecting was both a hobby and a serious scientific activity in the eighteenth century. Sir Hans Sloane, who was president of the Royal Society from 1727 to 1741, was a prodigious collector of plants, animals, and other curiosities. His 50,000 volume library and his various collections of metals, minerals, curiosities, etc. became the beginning of the British Museum. Sir Joseph Banks, president of the society from 1778 to 1820, was also a great collector of plants and insects. The type of collector usually satirized, however, was one like William Stukeley. Weld quotes the following passage from Stukeley's _Journal_:

"28 _Aug_. 1751.--Celebrated the dedication of my library; present, the President, Mr. Folkes, Mr. Fleetwood, Dr. Parsons, Mr. Pard . . . At the little window, which I called the sideboard, we began the entertainment with three sorts of plumb-pudding stone, with other natural and antique curiosities. The great window was spread over entirely with fossils of all kinds, which were extremely admired. The great lump of _Coralliam Tabulatum_, found in the river Ribble; another lesser lump, white; another, filled full with juice of black flint, which I picked up from the pavement of pebbles before my neighbour Curtis's door at Stamford. . . . I shew'd the bone I took out of the stratum of brick-earth in digging at Bloomsbury . . .

"I also show'd many sorts of _cornu ammonis_; a model of Stonehenge, some of the stone, the common sort polish'd a Roman cup and saucer, entire . . . Bishop Cumberland's clock, with the first long pendulum. After this dry entertainment we broach'd a barrel of fossils from the isle of Portland.

"Lastly, to render it a complete rout, I produc'd a pack of cards made in Richard II's time; and shew'd the British bridle dug up in Silbury Hill, probably the greatest antiquity now in the world," (I, 526-27).

[109]_Tatler_, No. 216 (Aug. 26, 1710), in _The Tatler_, ed. George A. Aitken (London: Duckworth and Co., 1899), IV, 112-13.

[110]_Tatler_, No. 216, IV, 110.

[111]_Tatler_, No. 216, IV, 110-11.

[112]_Tatler_, No. 221 (Sept. 7, 1710), IV, 133-36.

113 *Tatler*, No. 216, IV, 111.

114 Alexander Pope, *The Dunciad*, ed. James Sutherland, 3rd ed. rev., *The Poems of Alexander Pope*, V (London: Methuen and Co., and New Haven: Yale University Press, 1963), ll. 395-435, pp. 381-83.

115 Samuel Johnson, *Rambler*, No. 82 (Dec. 29, 1750), in *The Rambler*, ed. W. J. Bate and Albrecht B. Strauss, *The Yale Edition of the Works of Samuel Jounson*, IV (New Haven and London: Yale University Press, 1969), p. 69.

116 *Rambler*, No. 83 (Jan. 1, 1751), IV, 71-72.

117 *Rambler*, No. 83, IV, 72.

118 *Rambler*, No. 83, IV, 72-73.

119 *Rambler*, No. 83, IV, 73.

120 *Rambler*, No. 83, IV, 74.

121 *Rambler*, No. 83, IV, 74-75.

122 Bacon, *Novum Organum*, Aphorism 95, p. 392.

Chapter III

[1]Jonathan Swift, *A Tale of A Tub, With Other Early Works: 1696-1707*, *The Prose Works of Jonathan Swift*, ed. Herbert Davis, I (Oxford: Shakespeare Head Press, 1939), p. 65.

[2]Swift, *Tale of A Tub*, p. 66.

[3]Swift, *Tale of A Tub*, p. 67.

[4]Swift, *Tale of A Tub*, p. 70.

[5]Swift, *Tale of A Tub*, p. 67.

[6]Swift, *Tale of A Tub*, p. 66.

[7]Swift, *Tale of A Tub*, p. 68.

[8]*Spectator*, No. 31 (April 5, 1711), in *The Spectator*, ed. Donald F. Bond (Oxford: At the Clarendon Press, 1965), I, 127-28.

[9]*Spectator*, No. 452 (Aug. 8, 1712), IV, p. 93.

[10]*Spectator*, No. 457 (Aug. 14, 1712), IV, pp. 111-12.

[11]*Spectator*, No. 457, IV, p. 111.

[12]*Spectator*, No. 220 (Nov. 12, 1711), II, 356-57.

[13]*Spectator*, No. 28 (April 2, 1711), I, 115.

[14]*Spectator*, No. 251 (Dec. 18, 1711), II, 474-75.

[15]*Spectator*, No. 535 (Nov. 13, 1712), IV, 410.

[16]*Daily Post*, April 22, 1720, quoted in Virginia Cowles, *The Great Swindle: The Story of the South Sea Bubble* (London: Collins, 1960), pp. 121-22.

[17] Cowles, pp. 121-25.

[18] Cowles, pp. 123-25.

[19] Cowles, pp. 26, 53, 125.

[20] L[eslie] S[tephen], "Samuel Pepys," *DNB*.

[21] D[aniel] Ll[eufer] T[homas], "Richard Vaughan," *DNB*, and *Record of the Royal Society*, p. 385.

[22] J[ohn] K[nox] L[aughton], "Thomas Herbert," *DNB*, and Dorothy Stimson, *Scientists and Amateurs: A History of the Royal Society* (New York: Henry Schuman, 1948), p. 100.

[23] R[obert] D[unlop], "Sir Robert Southwell," *DNB*.

[24] G[eorge] F[isher] R[ussell] B[aker], "Charles Montague, Earl of Halifax," *DNB*.

[25] J[ames] M[cMillen] R[igg], "John Somers," *DNB*, and *Record of The Royal Society*, p. 388.

[26] *Record of the Royal Society*, pp. 387,388.

[27] *Record of the Royal Society*, p. 567, and Thomson, pp. 7-8.

[28] A[gnus] M[ary] C[lerke], "Edmund Halley," *DNB*.

[29] Louis Trenchard More, *Isaac Newton: A Biography* (New York and London: Charles Scribner's Sons, 1934), pp. 298-317.

[30] More, pp. 338-42.

[31] More, pp. 345-46, 354-55.

[32] More, pp. 356, 436.

[33] More, pp. 445-48.

[34]More, pp. 445-48, and Cowles, p. 141.

[35]More, p. 448.

[36]*Tatler*, no. 218 (August 31, 1710), IV, 121.

[37]*Spectator*, No. 543 (Nov. 22, 1712), IV, 443, and *Spectator*, No. 554 (Dec. 5, 1712), IV, 448.

[38]Weld, I, 373.

[39]John M. Monro, "Book III of *Gulliver's Travels* Once More," *English Studies*, 49 (1968), 433-44.

[40]Jonathan Swift, *Gulliver's Travels*, ed. Harold Williams, *Prose Works*, XI (Oxford: Shakespeare Head Press, 1941), p. 148.

[41]Swift, *Gulliver's Travels*, p. 146.

[42]Swift, *Gulliver's Travels*, p. 150.

[43]Swift, *Gulliver's Travels*, p. 148.

[44]Arthur E. Case, *Four Essays on Gulliver's Travels* (Princeton: Princeton University Press, 1945), pp. 82-84.

[45]More, p. 453.

[46]More, p. 289, and Marjorie Hope Nicolson, *Science and Imagination* (Ithaca, New York: Great Seal Books, 1956), pp. 119-20 and n.

[47]More, pp. 510-19 and 543-49.

[48]More, p. 663.

[49]Nicolson, *Science and Imagination*, pp. 123-32.

[50]Case, pp. 90-91.

[51]Nicolson, *Science and Imagination*, p. 135.

[52]Nicolson, *Science and Imagination*, pp. 135-52.

[53]Swift, *Gulliver's Travels*, p. 171.

[54]Swift, *Gulliver's Travels*, pp. 160-61.

[55]Swift, *Gulliver's Travels*, p. 161.

[56]Samuel Brunt (pseudonym), *A Voyage to Cacklogallinia: With a Description of the Religion, Policy, Customs and Manners of That Country* (1727; facsimile rpt. New York: Published for the Facsimile Text Society by Columbia University Press, 1940).

[57]Brunt, pp. 111-19. This discussion is devived from John Wilkins, *The Discovery of A New World*, in *The Mathematical and Philosophical Works of the Right Reverend John Wilkins, Late Lord Bishop of Chester* (London: Printed for J. Nicholson, et al., 1708), pp. 1-274.

[58]Brunt, pp. 136-37.

[59]Brunt, p. 137.

[60]Brunt, pp. 46-47.

[61]Brunt, pp. 72-76.

[62]Brunt, p. 167.

[63]Samuel Johnson, *Adventurer*, No. 99 (Oct. 16, 1753), *The Idler and The Adventurer*, ed. W. J. Bate, John M. Bullitt, and L. F. Powell, *The Yale Edition of the Works of Samuel Johnson*, II (New Haven and London: Yale University Press, 1963), pp. 433-35.

[64]Wolf, II, pp. 612-24.

Chapter IV

[1]Robert Boyle, "Some Considerations Touching the Usefulness of Experimental Natural Philosophy. Proposed in a familiar Discourse to a Friend, By way of Invitation to the Study of it," in _The Works of the Honourable Robert Boyle_, a new edition (London: Printed for W. Johnson, et al., 1772), II, 6.

[2]Boyle, II, 20-30.

[3]Boyle II, 19.

[4]Boyle II, 30.

[5]"An Exact copy of the last will and testament of the honourable _Robert Boyle_," _Works_, I, clxvii.

[6]Letter from Newton to Bentley, quoted in More, p. 377.

[7]Samuel Clarke, _A Collection of Papers, which passed between the late Learned Mr. Leibnitz, and Dr. Clarke, in the Years 1715 and 1716, Relating to the Principles of Natural Philosophy and Religion_ (London: Printed for James Knapton, 1717), pp. vi-viii.

[8]William Derham, _Physico-Theology: or, A Demonstration of the Being and Attributes of God, from His Works of Creation_. 8th ed. (London: Printed for W. Innys and R. Manby, 1732), pp. /iii/-iv.

[9]Stephen Hales, _Vegetable Staticks: or, An Account of Some Statical Experiments on the Sap in Vegetables: Being an Essay towards a Natural History of Vegetation_ (London: Printed for W. and J. Innys, 1727), sig. A3.

[10]J/ohn/ T/heophilus/ Desaguliers, _A Course of Experimental Philosophy_ (London: Printed for John Senex, et al., 1734), I, sig. A2.

[11]Joseph Priestley, _Experiments and Observations on Different Kinds of Air, and Other Branches of Natural Philosophy, connected with the Subject_ (Birmingham: Printed by Thomas Pearson, 1790), I, xxi-xxii.

[12]Richard Blackmore, _Creation; A Philosophical Poem_, in _Minor English Poets 1660-1780: A Selection from Alexander Chalmers' The English Poets /1810/_, comp. by David P. French (New York: Benjamin Blom, 1967) III, 22.

[13]_Spectator_, No. 399 (March 29, 1712), III, 261.

[14]Blackmore, p. 29.

[15]Blackmore, pp. 29-30.

[16]_Spectator_, No. 393 (May 31, 1712), III, 475.

[17]From the _Monthly Review_, quoted in Weld, I, 486-87.

[18]Oliver Goldsmith, _A Survey of Experimental Philosophy, Considered in its Present State of Employment_ (London: Printed for T. Carnan and F. Newbury, 1776), I, 17-18.

[19]_Spectator_, No. 554 (Dec. 5, 1712), IV, 487-88.

[20]_Spectator_, No. 554, IV, 488.

[21]_Spectator_, No. 554, IV, 488.

[22]_Spectator_, No. 554, IV, 489.

[23]_Spectator_, No. 543 (Nov. 22, 1712), IV, 442.

[24]_Spectator_, No. 635 (Dec. 20, 1714), V. 171.

[25]Alexander Pope, "Epitaph. _Intended for Sir_ Isaac Newton, _In Westminster-Abbey_," in _Minor Poems_, ed. Norman Ault, comp. John Butt, _The Poems of Alexander Pope_, VI (London: Methuen and Co., and New Haven: Yale University Press, 1954), p. 317.

[26]William Cowper, "The Task," III, ll. 243-54, in _Cowper: Poetical Works_, ed. H. S. Milford, 4th ed., corr. Norma Russell (London: Oxford University Press, 1967), p. 169.

[27]James Thomson, "To the Memory of Sir Isaac Newton," ll. 15-16, in _James Thomson: Poetical Works_, ed. J. Logie Robertson (London: Oxford University Press, 1965), p. 436.

[28]Thomson, ll. 68-75, 137-43, pp. 438, 440.

[29]Matthew Prior, _Solomon on the Vanity of the World. A Poem in Three Books_," III, l. 884, in _The Literary Works of Matthew Prior_, ed. H. Bunker Wright and Monroe K. Spears, 2nd ed. (Oxford: At the Clarendon Press, 1971), I. 384.

[30]Boyle, II, p. 10.

[31]Hales, sig. A2-A3.

[32]Prior, I, ll. 191-98, p. 316.

[33]Prior, I, ll. 405-18, p. 322.

[34]Prior, I, ll. 473-80, p. 324.

[35]Prior, I, ll. 739-59, pp. 331-32.

[36]Alexander Pope, _An Essay on Man_, ed. Maynard Mack, _The Poems of Alexander Pope_, IIIi(London: Methuen and Co., 1950), II.i.19-30, pp. 56-59.

[37]Pope, _An Essay on Man_, II.i.35-42, p. 60.

[38]Pope, _An Essay on Man_, II.i.43-52, pp. 61-62.

[39]Bacon, _Novum Organum_, Aphorism 128, p. 417.

[40]Cowper, _The Task_, III, ll.221-39, p. 169.

[41]Boyle, II, 10.

[42]Hales, sig. A3.

[43]Priestley, I, xxviii.

[44]Samuel Johnson, "The Vanity of Human Wishes," ll. 135-46, 155-59, in Poems, ed. E. L. McAdam, Jr., and George Milne, Yale Edition of the Works of Samuel Johnson, VI (New Haven and London: Yale University Press, 1964), pp. 97-99.

[45]Samuel Johnson, The History of Rasselas, Prince of Abissinia, ed. Geoffrey Tillotson and Brian Jenkins (London: Oxford University Press, 1971), pp. 122-23.

[46]Boyle, II, 64.

[47]Hales, p. iv.

[48]Erasmus Darwin, Zoonomia; or, The Laws of Organic Life (Dublin: Printed for P. Byrne, and W. Jones, 1794), I, 1.

[49]Darwin, I, 2.

[50]Desaguliers, I, sig. A2.

[51]Priestley, I, [v].

[52]Priestley, I, x-xi.

[53]"Preface," Gentlemen's Magazine, Vol XI (1741).

[54]"Preface," Gentlemen's Magazine, Vol. XIII (1743).

[55]"Preface to Vol. XIX," Gentlemen's Magazine, Vol. XIX (1749).

[56]"Preface to Vol. XXIII," Gentlemen's Magazine, Vol. XXIII (1753).

[57]"Preface," Gentlemen's Magazine, Vol. LX (1790).

[58]It is interesting to compare these figures to Thomas Thomson's computations of the number of articles in various fields published in the Philosophical Transactions from 1665 through the eighteenth century. He shows that the greatest number of articles was published in medicine (699), followed by physics (419), astronomy (416), chemistry (406),

inventions (298), zoology (290), and meteorology (281). Again, a noticeable number of practical sciences are included in the list. It is also interesting that, though the period covered in the Gentlemen's Magazine survey represents only 1/14th the period of time represented by the Philosophical Transaction figures, the Phil. Trans. figures are almost consistently only four times as large.

[59] Priestley, I, xix.

[60] Priestley, I, xviii.

[61] Priestley, I, xxii.

[62] Priestley, I, xxii-xxiii.

[63] Priestley, I, xxiii.

[64] Johnson, The Adventurer, No. 99 (Oct. 16, 1753), II, 434.

[65] Ralph Morris, A Narrative of the Life and astonishing Adventures of John Daniel, A Smith at Royston in Hertfordshire (London: Printed for M. Cooper, 1751), p. 4.

[66] Morris, p. 16.

[67] Morris, pp. 149-50.

[68] Morris, p. 182.

[69] Morris, pp. 144-45.

[70] Morris, pp. 277-78.

[71] Morris, pp. 311-12.

[72] Morris, p. 316.

[73] Robert Paltock, The Life and Adventures of Peter Wilkins, ed. Christopher Bentley (London: Oxford University Press, 1973), p. 50.

[74]Paltock, pp. 66-67.

[75]Paltock, pp. 372-73.

[76]Paltock, p. 215.

[77]Paltock, p. 243.

[78]Paltock, p. 247.

[79]Johnson, Rasselas, p. 17.

Chapter V

[1]Frederick L. Jones, ed. Mary Shelley's Journal (Norman, Ok.: University of Oklahoma Press, 1947), pp. 67-68, 73.

[2]Percy Bysshe Shelley, Letters, ed. Frederick L. Jones (Oxford: At the Clarendon Press, 1964), I, 319.

[3]Jones, Journal, pp. 73, 220.

[4]Humphrey Davy, "A Discourse Introductory to a Course of Lectures on Chemistry," in Early Miscellaneous Papers, Vol II of The Collected Works of Sir Humphrey Davy, ed., John Davy (London: Smith, Elder and Co. 1839), p. 310. Hereafter cited "Discourse."

[5]"Discourse," p. 311.

[6]"Discourse," p. 315.

[7]"Discourse," p. 318.

[8]"Discourse," pp. 318-19.

[9]"Discourse," pp. 320-21.

[10]"Discourse," p. 321.

[11]"Discourse," p. 319.

[12]"Discourse," pp. 322-23.

[13]"Discourse," p. 324.

[14]"Discourse," p. 325.

[15]"Discourse," p. 326.

[16]Priestley, I, xxiii.

[17] Priestley, I, xxxi.

[18] Mary W. Shelley, Frankenstein: or The Modern Prometheus, ed., M. K. Joseph (London: Oxford University Press, 1969), pp. 36-37. Hereafter cited Frankenstein.

[19] Frankenstein, p. 39

[20] Frankenstein, p. 40.

[21] Frankenstein, p. 41.

[22] Frankenstein, p. 47.

[23] Frankenstein, pp. 47-48.

[24] "Discourse," p. 321.

[25] Frankenstein, p. 48.

[26] "Discourse," p. 319.

[27] Frankenstein, p. 49.

[28] "Discourse," p. 314.

[29] Frankenstein, pp. 52-53.

[30] Frankenstein, p. 52.

[31] Writing in 1812, Thomas Thomson compared Davy to two other "new British chemists." ". . . we may mention that three distinct schools, (if we may use the expression) have been established by three gentlemen, certainly not the least celebrated among British chemists," he said. "These are, Dr. Wollaston, who possesses an uncommon neatness of hand, and who has invented a very ingenious method of determining the properties and constituents of very minute quantities of matter. . . . The second of these schools has been established by Mr. Davy, whose galvanic discoveries and analyses of the alkalies have constituted a new era in the science, and furnished us with a totally new method of experimenting. Mr. Davy is the most active as well as

celebrated chemist in Great Britain, and many more discoveries may be expected from him. The third school has been established by Mr. Dalton, who has not yet obtained that degree of celebrity in this country to which he is entitled, and which he will infallibly acquire," (pp. 484-85). Thomson's quote illustrates how firmly Davy was associated with galvanic chemistry in the early nineteenth century and how optimistic writers like Thomson were concerning the future of this branch of chemistry.

[32]Theodore M. Brown, "Luigi Galvani," Dictionary of Scientific Biography (New York: Charles Scribner's Sons, 1972).

[33]Humphrey Davy, "A Syllabus of a Course of Lectures on Chemistry," in Early Miscellaneous Papers, II, 409.

[34]Humphrey Davy, "Outlines of a Course of Lectures on Chemical Philosophy," in Early Miscellaneous Papers, II, 448.

[35]"Discourse," pp. 313-14.

[36]Frankenstein, pp. 51-52.

[37]Frankenstein, p. 57.

[38]Frankenstein, p. 9.

[39]Erasmus Darwin, The Temple of Nature; or,The Origin of Society: A Poem, with Philosophical Notes (London: Published by Jones & Company, 1824), Canto I, ll. 235-50, p. 13.

[40]Frankenstein, p. 53.

[41]"Discourse," p. 321.

[42]"Discourse," p. 322.

[43]Frankenstein, p. 50.

[44]Frankenstein, p. 54.

[45] *Frankenstein*, p. 90.

[46] *Frankenstein*, pp. 28-29.

[47] *Frankenstein*, p. 55.

[48] *Frankenstein*, pp. 93-94.

[49] *Frankenstein*, p. 160. The lightning symbol is discussed in Wilfred Cude, "Mary Shelley's Modern Prometheus: A Study in the Ethics of Scientific Creativity," *Dalhousie Review*, 52 (1972), 219.

[50] *Frankenstein*, p. 168.

[51] *Frankenstein*, p. 167.

[52] Cude, p. 221.

[53] *Frankenstein*, p. 219.

[54] *Frankenstein*, p. 37.

[55] *Frankenstein*, p. 38.

[56] *Frankenstein*, p. 158.

[57] Concerning the study of magnetism, Thomas Thomson says: "Although magnetism is of more practical utility to mankind than electricity, it cannot be said, as a science, to have made much progress," (p. 458).

[58] *Frankenstein*, p. 16. In 1746 Parliament offered a reward of £20,000 to any ship that discovered a sea passage between the Atlantic and Pacific oceans. By 1773 the Royal Society was sponsoring scientific expeditions whose purpose was to attempt to reach the pole and to search for such a passage, (Weld, II, 70-74). Like Frankenstein, then, Walton was pursuing studies closely related to scientific work attracting public attention in the late eighteenth and early nineteenth centuries.

[59] *Frankenstein*, pp. 16-17.

60 *Frankenstein*, p. 17.

61 *Frankenstein*, p. 17.

62 *Frankenstein*, pp. 21-22.

63 *Frankenstein*, p. 19.

64 *Frankenstein*, p. 27.

65 *Frankenstein*, pp. 217-18.

66 *Frankenstein*, p. 214.

67 *Frankenstein*, p. 28.

68 *Frankenstein*, p. 28.

69 *Frankenstein*, p. 215.

70 *Frankenstein*, p. 215.

71 *Frankenstein*, p. 215.

72 *Frankenstein*, p. 215.

73 *Frankenstein*, pp. 218-19.

74 *Frankenstein*, p. 219.

75 *Frankenstein*, p. 219.

76 *Frankenstein*, p. 221.

77 "Discourse," p. 322.

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