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Effective Thinking

WARREN J. WINSTEAD

AS THE SCOPE and volume of management decisions have mounted in this complex, technologically oriented era, increasing attention has been focused by government and industry alike upon the ability of their executives to think a problem through effectively to its ultimate conclusion. Executive training programs to encourage managers to think more effectively have been conducted by the American Management Association, various industries, and the government. These programs have evolved around such topics as "Problem Solving Techniques," "Decision Making," "Creative Thinking," "Sensitivity Group Training," and others.

This article will discuss only two basic aspects of an individual's ability to think effectively: first, the ability to identify a problem and to decide in a rational and systematic manner upon a course of action which will lead to its ultimate resolution; and second, the ability to deal with new and unique problems which by their nature are not susceptible to a systems approach but require a more specific decision by management for resolution.

Let us start with problem solving. It has been said that a computer with the capacity to simulate the human brain would encompass a city block and require all of the water in Niagara Falls to cool it. The mind may be compared to a computer in the sense that it can store and retrieve data, can organize data systematically, can perform intricate computations and can solve complex problems. The mind must be trained, how-

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ever, to accomplish these actions in a systematic and efficient manner.

The ability to think systematically or logically through a series of events to the ultimate resolution of a particular problem is called the scientific method. It involves thinking either **deductively,** i.e., going from a general principle to its particular application, or **inductively,** i.e., going from the particular to the general.

For added clarity, we will define "logic" as a science of those principles, laws, and methods which the mind of man must follow for the secure and accurate attainment of truth. There are generally two kinds of logic: common or "horse sense," which is developed by random exposure through life to myriads of simple and complex problems that the mind can solve if left to formulate its own system of efficiency; and scientific logic, which is natural logic that the mind has been trained to recognize and apply.

In most executive training programs, managers are taught to follow a very simple but systematic procedure which experience has proved effective in the resolution of specific management problems. The sequence of analysis is as follows: (1) assemble all available facts pertaining to the situation; (2) identify the primary problem and any other related problems; (3) define the primary problem (At this point many problems resolve themselves. One of the most frequent and difficult situations which an executive must face is his inability to define a problem or to articulate it clearly enough that others can understand its ramifications); (4) determine the cause(s) of the particular problem in question; (5) select possible courses of action (At this point the problem-solving method often merges into the decision-making process, since the next step is part of that process); (6) decide on a best course of action; (7) determine how to implement this course of action most effectively; (8) establish controls or check points to insure that the actions taken follow a predetermined sequence and timetable of events until the problem is resolved.

Philosophers have dealt with decision making through procedures which they relate to formal logic, an area of philosophy on which considerable interest is being focused today because of its implications for computers. This process involves such things as finite mathematics and the old exercise in logic known as a "truth table." Many philosophers refer to the ability to solve or resolve problems as philosophic-mindedness. In other words, an effective thinker is one who thinks philosophically, and a person who thinks philosophically is a philosophic-minded individual. There are certain characteristics of philosophic-mindedness which tend to relate directly to the ability of the individual to solve problems.

The first of these characteristics is **comprehension,** which encompasses (a) the ability to view particulars with relation to a large field, (b) the ability to relate immediate problems to long-range goals, (c) the power to generalize, and (d) a tolerance for theoretical considerations.

The second characteristic is **penetration.** In this regard we find (a) the habit of questioning what is generally thought to be self-evident or taken for granted, (b) the practice of seeking for and formulating the fundamental ideas for developing a routine, (c) a sensitivity for implication and relevance, (This sometimes relates to the ability to think creatively which I will touch on later in this paper), and (d) the basing of expectations on an abductive-deductive relationship rather than on a purely inductive process, moving beneath the surface of the problem.

The third characteristic is **flexibility,** which includes (a) freedom from psychological rigidity, (b) evaluation of ideas apart from the source, (c) seeing issues as many-sided rather than just two-sided, (d) tolerance for tentativeness and suspended judgment, and (e) willingness to take action in an ambiguous situation. This latter facet is more closely related to the decision-making process which I will consider next.

I have previously defined the terms "deductive" and "inductive." Now, I would like to touch briefly on the term "abductive" which is drawn from Peircean philosophy. The abductive approach to a problem is a logically indeterminate generalization, posing the question of how to account for the observation. It employs a process of directed trial and error to establish hypothesis — sometimes referred to as the creative element in reflection.

Lincoln Steffens, in his autobiography, refers to a conversation aboard ship with Woodrow Wilson, and quotes Mr. Wilson as stating: "An executive is a man of action. An intellectual — such as you and I — is inexecutive. In an executive job we are dangerous, unless we are aware of our limitations and take measures to stop our everlasting disposition to think, to listen, to not act. I made up my mind long ago when I got my first executive job to open my mind for a while, hear everybody who came to me with advice, information — what you will — then, someday, a day when my mind felt like deciding, to shut it up and act. My decision might be right, it might be wrong. No matter, I would take a chance and do — something."

The decision-making process generally incorporates all of the factors of problem-solving, logic and philosophic-mindedness with two added ingredients. First, a limitation of time and second, the necessity to act without complete information. Here the individual differs from the computer which can, at a moment's notice, scan all available information on a particular subject, make the necessary computations, and come up with the probability of a successful decision based upon the information which has been stored in its memory bank. The individual cannot scan systematically all of the information he has stored over a period of time, nor is he able to make available instantly the computations that will assure a high probability of success in the decisions he makes.

Normally one thinks of a logical approach to problem solving as the only process related to effective thinking. However, there are a number of problems which cannot be solved in a logical and systematic manner. Further, there are many problems that need unusual solutions. The mere fact that we do not have complete data when we resolve the majority of problems with which we are faced means that, although we would prefer to follow a systematic approach to problem solving — and with this approach increase the odds in favor of reaching the best answer — there are often times when the human mind must follow a "hunch" or a guess, or develop a solution when the odds are not in our favor. Buckler, in **The Philosophy of Charles Sanders Peirce,** quotes Peirce on the "abductive" process:

> "Observed facts relate exclusively to the particular circumstances that happen to exist when they were observed. They do not, in themselves, contain any practical knowledge. Such knowledge must involve additions to facts observed. This we can control; however, error is liable to creep in. Any proposition added to observed facts tending to make them applicable in any way in other circumstances to those under which they were observed may be called a hypothesis. The first starting of a hypothesis and the entertaining of it, is an inferential step which we shall call "abduction" — the operation of adopting an explanatory hypothesis. Induction infers that throughout a whole class a ratio will have about the same value it has as a random sample of that class. Induction partakes of abduction in involving an original suggestion. Abduction is the questioning approach to induction-deduction. Abductive inference shades into perceptual judgement without any sharp line of demarcation between them. Or, in other words, our first premises, the perceptual judgements, are to be regarded as an extreme case of abductive inferences, from which they differ in being absolutely beyond criticism. The abductive selection comes to us like a flash. It is an insight, although of extremely fallible insight. It is true that the different elements of the hypothesis were in our minds before, but it is the idea of putting together what we have never before dreamed of putting together which flashes the new suggestion before our contemplation. This process of forming perceptual judgement, because it is subconscious, and so not amenable to logical criticism, does not have to make separate acts of influence, but performs its acts in one continuous process."

The above quotation could well form the philosophic base for what has emerged recently among executive groups as the need to develop the ability to think creatively, or to develop what Alex Osborne calls it in his book, "applied imagination." It is commonplace today to find among major industries such things as brain-storming sessions following the Osborne technique. Such sessions are used to resolve problems which the executive group have been unable to resolve individually through a systematic problem-solving procedure. This technique involves the assembling of those who have been dealing with the problem at the highest level, setting a particular number of reactions which one would expect from this group, and then requiring each member of the group, in turn, to state some new approach to the problem, literally "off the top of his head." The group is conditioned to the necessity to react even though such reaction produces unconventional or unusual solutions. The reaction climate is stimulated by the fact that no one will think negatively of what normally might be considered a "crazy idea." From one of these brain-storming sessions can come several hundred suggested solutions or new directions, which are then organized, systematically grouped under sub-headings, and thoroughly investigated. It is interesting to find how many solutions are obtained at sessions of this sort from people who would not suggest them in the normal course of events because of their inability to defend their hypotheses logically.

Another aspect of creative thinking is sometimes called "incubation." This process has been used by many of our great scientists, unknowingly perhaps, in their approach to some of the leading discoveries of our century. Very simply stated, incubation is forgetting about the problem after examining all its aspects and exhausting all conscious means of approach to it, diverting oneself for an indefinite period of time, and then returning to the problem. Placing a problem in incubation is simply diverting oneself to some other activity that is so completely absorbing that it pushes the problem to be solved completely out of the conscious mind. Indeed, one might incubate a problem simply by taking a nap. It is surprising how many times the solution to a problem will appear in a flash, during sleep in the middle of the night, on a golf course or, as one of our recent Nobel Laureates found, while walking down the street in a major city coping with the movement of traffic.

In conclusion, I would like to point out the three major deterrents to effective thinking. First is rapport, or the degree of psychological affinity that one individual has with another. We often make value judgments based on our rapport with the individual who is sending a problem to us for a decision or an evaluation. The second major deterrent is our tendency to rationalize. Once we have committed ourselves to a decision or an idea we defend it after the fact, sometimes forcing the problems to meet our preconceived solutions. The third deterrent to logic is ego — letting the problem or our ability to think effectively through it, be influenced by our own particular sense of status. Fear of failure and inability to adjust to a different course of action are underlying factors in cases of this nature.

Documentation and the Librarian

ROBERT J. HAVLIK

THERE IS presently a great deal of confusion over the use of the term "documentation"—what it is and how it is related to librarianship. Some view it as part of the knowledge of librarianship; others believe it is a separate discipline.

The two following statements from a recent issue of the **SLA Bulletin-Southern California Chapter** are illustrations of the poles of attitudes taken by administration toward documentation and mechanization of library procedures.

1. The need to eliminate reliance on a human operator is the most important need in library processing. Manual processing work required skill and training. Absenteeism, the need for training and required skill are problems that can be overcome largely with the use of mechanical methods.
2. We look on our library not as a repository of massive data with routine retrieval, but as a wide angle window on the technical world outside. The critical attributes, therefore, are intelligence, professional knowledge, and technique and flexibility, rather than mechanical efficiency.[1]

These statements illustrate the confusion of the intellectual requirements of information handling with particular mechan-

[1]Harriman, T. J., VP-Director of Engineering, Giannini Controls Corp. **"The Special Library and its Services"** in SLA Bulletin-Southern California Chapter, Vol. 25, No. 3, Spring 1964, p. 88.

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isms for carrying out part or all of the work that is needed to meet the requirements.

This paper will deal with some of the basic concepts of documentation and information handling which I hope will be a step toward better understanding the role of documentation in librarianship.

The Information Explosion—The Origination of the Problem

Mr. J. W. Senders of Bolt Beranek and Newman, Inc., in an article in **Science** Vol. 141, 1963, p. 1067-1068, states, ". . . the world's store of printed matter stands now at approximately 200 million different books, or about 2×10^{13} words." The amount is doubling every 15 to 20 years. If this rate of increase continues, in the year 2,000, the number of library holdings will amount to five times the present number. Other experts in the field estimate that during every 60 seconds of the 24 hour day more than 2,000 pages of text, newspapers, reports, and books are published in the world. This vast outpouring of information has been labeled "information crisis."

The "information crisis" in science is most acute, since the product of research is information. For this reason it has had most attention in recent years. The following is a brief history of the problem:

The earliest surviving scientific periodical is the **Philosophical Translations of the Royal Society of London** which was first published in 1665. It was followed rapidly by some three or four similar journals published by other national academies in Europe. Thereafter, the number grew to a total of about 100 by the beginning of the 19th century, 1,000 by the middle and some 10,000 by 1900. According to the **World List of Scientific Periodicals,** we are now well on the way to the next milestone of 100,000 such journals. Estimating roughly, we can say that the number of new scientific journals has increased by a factor of ten every half century from the base year of 1750, when the growth was stabilized. By the year 1830, the number of new journals reached a point where there was more literature than a scientist could read. At this point the first separate abstracting journal appeared. Soon the number of abstract journals also grew. This growth was by a rough factor of 10 in every half century. The total reached about 300 by 1950. In 1950 the situation was comparable to that for journals in 1830, and scientists began talking about abstracting abstract journals. It is at this point scientists began to mention this as an "information problem" which seemed to require some process of electronic sorting and organization as a means of coping with the literature.

It was the shock of the Russian Sputnik that forced librarians to take action in the field. Librarians suddenly realized how unprepared they were professionally to handle this new problem. The reason is related to the historical role libraries have played in the United States. The significance of the library in our democracy has led to a greater emphasis within the library profession on the social role of libraries. This has tended to distract the attention of the profession from building a specialized body of knowledge based on the organization and utilization of information. It is the development of this body of knowledge with which documentation is now attempting to deal. This new orientation can be best illustrated by quoting a few well known librarians on their definition of documentation. Dr. Jesse H. Shera, Dean and Professor of Library Science, School of Library Science, Western Reserve University, Cleveland Ohio:

"Documentation is a theory of librarianship that is dedicated to the exploration of new ways for improving the utility of recorded knowledge, for whatever purpose and at whatever level of use, by developing new means for the analysis, organization and retrieval of graphic records. Documentation then . . . is a credo — a professional philosophy."

Dr. Ralph Shaw, Dean of Library Activities, University of Hawaii:

"Documentation is best differentiated from normal library services by the extent to which it is concerned with a complete-cycle service providing information. This cycle involves the identification, recording, organization, storage, recall, conversion into more useful form, synthesis, and dissemination of the intellectual content of print and other recorded materials."

In other words, documentation is librarianship with emphasis on the science of handling information.

What Does Documentation Cover?

The National Science Foundation, Office of Information Service has grouped documentation research into five main categories. A discussion of these categories may aid in understanding the field.[2]

1. Research on Information Needs and Uses — This category includes studies and analysis of the information needs of the clientele, of the uses made of the information, and other communications problems, including publication studies and experiments with new publishing formats and techniques.

One conclusion drawn from past work in this area is that the determination of user requirements for information should be viewed as a system problem in which the needs of the individual user of information must be considered in context of the total system in which he operates. It has recently been suggested that instead of studying types of users of information, more progress would be made by examining the different categories of information usage which may vary from a search for a specific document to a search for new and stimulating research ideas.

2. Research on Information Storage and Retrieval — This includes studies of methods, systems, and procedures for analyzing, organizing, encoding, storing, and searching subject matter, including theoretical studies of information storage and retrieval.

[2]Current Research and Development in Scientific Documentation No. 11, National Science Foundation, Office of Science Information Service, 1962

The most intensive work in this area has historically been in the field of information indexing techniques. For example, up until the 1950's there were only two methods of analyzing subject content of materials. One was a system of alphabetic subject cataloging and the system of cataloging with a hierarchical classification system. About 1950 a new indexing technique known as the Uniterm System was introduced. The basic philosophy of the Uniterm System is that subject analysis can be performed by less skilled personnel because the words of the author are taken and entered into the system, without hunting so-called subject concepts or attempting to fit the subject content into a hierarchical scheme of classification. The primary success of the Uniterm System thus has been attributed to the fact that it uses terminology that is more familiar to the user of the indexed information.

Another system is called the Descriptor Technique. The basic difference between both descriptors and subject headings and descriptors and Uniterms is that descriptors are more oriented to the viewpoint of a specialized group of users than are either subject headings or Uniterms.

Both of these methods of information analysis may be utilized in coordinate indexing techniques. Coordinate indexing is defined as including all systems in which logical operations of intersection, union, and negation are brought into play in the manipulation of index terms such as Uniterms or descriptors.

3. Mechanical Translation — This includes research on problems of automatic translation from one natural language to another.

This is a rather esoteric field and there are only a comparatively small number of groups in U. S. working on the problem. There is a growing bibliography in the field but the general purpose application of the research is many years away. The mere argument of "what makes a good translation," mechanical or otherwise, is still to be solved.

4. Equipment — This research includes development of

devices for the processing of information including devices for reading, sorting, searching, transmitting, and translating.

One general conclusion can be drawn here: man's limited manual ability expeditiously to process data from large files has become increasingly evident. In addition, it is obvious that (EAM) Electronic Accounting Machines have limitations because of excessive time needed to handle large amounts of punched cards and because of the economics of investing in and maintaining this equipment. High speed digital computers can eliminate the above timing problems and can eliminate some of the cost problems if they can be rented on an "as needed" basis.

5. Potentially Related Research — This includes category work on problems not immediately connected with documentation but whose solution is likely to have an impact on the future of documentation, including such fields as character and pattern recognition, speed analysis and synthesis, linguistic and lexicographic research, artificial intelligence, and certain psychological and sociological studies.

One interesting area of research is called character and pattern recognition research. This is divided into four phases: text and non-text reading and closed and open situations. A character recognizer is a device for scanning typed and printed characters, comparing the input image as a pattern against a set of reference patterns, identifying the input pattern, and providing a digital output symbol corresponding to an input pattern. In a closed situation you have complete control of format. Bank checks for example, which are coded for your bank alone, are part of a closed system. In an open system the individual has no control over input and the text may come from almost any source.

Artificial intelligence research is another interesting area under this category. Artificial intelligence research is of great importance to future computer research. Of increasing concern is the design of computer hardware capable of receiving and processing messages formulated in ordinary language. People doing this type of research are concerned with man-machine interactions, language comprehension, and the meaning and interpretation of various types of linguistic utterance. Conclusions reached from this research, however, have reinforced the fact that the human librarian is still on solid ground. The librarian, by proper use of man-to-man interactions, can easily arrive at a meaning and interpretation of a library user's linguistic utterances and get the man what he really had in mind. No machine system can do this yet.

In the fullest sense of the word, the problems which the age of the "information crisis" has generated are library problems. Research has shown that librarians can not dodge the responsibility of helping to solve them. Current trends in information production will force future students of library science to learn much more about the wide range of documentation techniques and methods.

An article in the April 17, 1964 (p. 244), issue of **Science** makes the following statement regarding obsolescence of fields of science:

"It seems likely that if a student has had a good undergraduate background in the sciences and applies himself well to the learning of one broad dicipline as a graduate student, he should be equipped to evolve with his field. If he has learned to think imaginatively and to read critically, then there is little danger of his becoming obsolete even if his original speciality becomes obsolete."

The implications of this statement to present and future librarians dealing with the information explosion is clear. Documentation will continue to be part of librarianship if the librarians keep open minds.

The Other Culture

MORRIS H. SHAMOS

A FEW years ago C. P. Snow claimed that by and large our Western Civilization is polarized into two main groups —literary intellectuals at the one pole and scientists at the other. There has since been much debate over his thesis, some claiming him totally unreasonable, others contending that if anything his criticism of literary intellectuals was much too mild.

It surprises me that anyone could question the basic premise that we are indeed polarized in this fashion. However idealistic one might be toward the goals of education he must be blind to reality if he imagines that we produce modern equivalents of the Renaissance Man. We produce scientists or humanists — rarely both in the same individual.

Let me therefore assume that we are a two-culture society and ask which indeed is the "other culture." The question does not admit of a simple answer, as we shall see. One might be tempted to regard the "other culture" as the one that is foreign to him. On the other hand, perhaps it is merely the one that is less important to society, assuming that this is a valid concept. For example, where a humanist might look upon science as the "other culture," a scientist might also regard it in the same light on the ground that it appears to have so little impact on society generally.

My own view goes much beyond this. We do have a two-culture society, to be sure, but in an age of specialization one could hardly expect otherwise. What is perhaps more to the

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point is that we have a double standard in education — in which ignorance of one culture (the scientific) is excusable while ignorance of the other is not. It is primarily this aspect of the problem that I wish to explore.

The goals of education have been stated in many ways, and I do not propose to add any more phrases to the already overburdened literature on the subject. But surely one of the most basic goals is to produce educated adults. The strange thing about our educational structure is that while we can easily recognize the end product we find it difficult to specify the ingredients.

One frequently hears it said that an educated person is familiar with the best that has been thought and said in the world of literature, in history, philosophy, in social theory and in the fine arts — in short, with those intellectual problems which occupy the minds of men, which provoke the community of scholars and which influence the thoughts and actions of a society. One could hardly deny that science ought to play a prominent role in such an intellectual scheme.

Then why is it not a part of the intellectual attainments of every scholar — indeed of every educated adult in our society? We know that his thoughts rarely turn to the great ideas on which we base our modern view of nature. Instead, his language and mode of life are primarily humanistic. Moreover, they are for the most part anti-intellectual. He responds more to pleasures of the eye and ear than to pleasures of the mind.

Perhaps the greatest myth of modern times is that we live in a scientific age. This may be so if judged by the massive technology that surrounds us, but not if measured by the scientific sophistication of our citizens. The truth is that we live in a humanistic society. Our thoughts and actions are guided far more by a humanistic culture than by a scientific one. We respond more to emotion than to reason, to fantasy more than to facts, and to words more than to ideas. In short, our culture leans more heavily on our senses than our minds.

How many of your acquaintances regard the reports of

UFO's as surely meaning visitors from outer space? How many believe that in games of chance the past determines the future? Or that we live in a universe in which events are completely preordained? I could go on and on to illustrate how naive our educated adults are in science, but I think the point is perhaps better made by an amusing example that occurred at the turn of the century. It has to do with the way science is frequently regarded by the public. Following are a few newspaper accounts of one of the major scientific discoveries of the past century:

> Vienna **Presse** — A few examples of this sensational discovery are being circulated in Vienna and deservedly are creating great amazement. The light rays from a Crookes tube penetrate dense objects as easily as sunlight penetrates a piece of glass. Biologists and physicians, especially surgeons, will be very much interested in the use of these rays, because they offer prospects of constituting a new and very valuable aid in diagnosis.

This appeared on Jan. 7, 1896, only a few days after a technical paper, entitled "A New Kind of Rays," was published in a scientific journal. On the next day there appeared the following story in the **Frankfurter Zeitung:**

> There are nine photographs in Vienna which Professor Roentgen has sent to one of his colleagues. (The practice of sending preprints is not only a contemporary one.) The most careful examinations of these photographs leave no doubt concerning the complete validity of Professor Roentgen's statements . . . The Wurzburg Professor discovered these unknown rays by accident, as happens so often when sensational truths are disclosed . . . The perspicacious professor followed up this (accidental) observation, and the familiar results of his discovery have just been reported.

Within the next few days the newspaper storm broke all over Europe and then throughout the world; the stories for the most part were embellished with fantastic speculations. The discovery, of course, was x-rays; the time, some 70 years ago, but it has its modern counterparts. Roentgen did not understand the origin of x-rays, of course, but at least he did not regard it as supernatural or even mysterious, as did so many of his literary contemporaries.

Cartoons, jingles, stories, all bearing on the "Peeping Tom" aspect of x-ray photography, literally flooded the magazines and newspapers. In London, only a month after the discovery was announced, a firm advertised the "sale of x-ray-proof under-clothing." Worse still, in New Jersey, Assemblyman Reed of Somerset County introduced a bill into the state legislature prohibiting the use of x-rays in opera glasses in the theaters. And New York newspapers reported:

> At the College of Physicians and Surgeons (Columbia) the Roentgen rays were used to reflect anatomic diagrams directly into the brains of the students, making a much more enduring impression than the ordinary methods of learning anatomical details.

Others thought that with the use of x-rays base metals might be transmuted to gold, vivisection would be outmoded, temperance promoted by showing drunkards the steady deterioration of their systems, and that even the human soul could be photographed.

Here was the reaction to one of the major discoveries of science — one that helped to reshape man's thinking from the classical, mechanistic view of the 19th century into the quantum physics of the present century. "How naive," one might say. But consider whether present-day reaction to scientific discoveries is really any less naive — or whether the general public, educated or not, is prepared to believe almost any pseudo-scientific idea if it somehow conforms to their personal view of how things ought to be.

The fact is that we are no more sophisticated in science now than were our ancestors a century ago. One should read the book by Martin Gardner entitled "Fads and Fallacies in the Name of Science." This is a contemporary book, first published in the present edition about 10 years ago, which describes in detail some of the frauds which are perpetrated on the public in the name of science. Among these is the work of Immanuel Velikovsky, who created a stir in 1950 when he published his "Worlds in Collision." In this book, as in all his works, he rewrites science to conform with the Old Testament. For example, according to Velikovsky, the Earth collided with a comet in 1500 B.C., at the time of the Israelite Exodus. This encounter caused the Earth either to stop spinning entirely or to slow down suddenly — the writer is not sure which. In either case, cataclysmic events occurred on Earth. Among these, it was the stopping of the Earth's spin that caused the Red Sea to divide precisely at the moment commanded by Moses, thereby permitting the Israelites to cross safely before the pursuing Egyptians were engulfed by the backwash.

A wild theory? Not any more so than most of its kind. The fact that it ignores contemporary science in favor of **ad hoc** inventions designed to make the case for its author is characteristic of this kind of fantasy. What is most alarming about it is the response it evoked among well-known, intelligent members of our literary community. As Mr. Gardner points out, many were taken in by it, evidently more by emotion than through reason. John O'Neill, who was then science editor of the New York Herald Tribune, described the work as "a magnificent piece of scholarly research." And Gordon Atwater, then chairman and curator of New York's Hayden Planetarium, stated that "the theories presented by Dr. Velikovsky are unique and should be presented to the world of science in order that the underpinning of modern science can be re-examined." He was ranked by one reviewer with Galileo, Newton, Planck, Einstein, etc., and Clifton Fadiman likened him to Leonardo Da Vinci. While admitting that he himself "had virtually no scientific training," Fadiman nevertheless said that he thought Velikovsky's thesis carried "a great deal of persuasion."

This is but one example of how the public welcomes scientific quackery with open arms. One could go on indefinitely, citing medical frauds, get-rich-quick schemes which prey on public ignorance of science, and the willingness of highly intelligent individuals to accept the most fanciful ideas about nature. As the **Saturday Review** put it in its review of Gardner's book . . . "Although we are amused, we may also be embarrassed to find our friends or even ourselves among the gullible advocates of plausible-sounding doubletalk."

I have tried to make the point that public understanding of science leaves much to be desired. I think there can be little argument about this conclusion. It is not a very original view, but it leads to a disturbing thought. After all, these educated adults who are so scientifically illiterate are the products of our educational system. We taught them their science, which one may take to mean that there is something seriously wrong with the way we teach science. This may be an unpopular suggestion, at least to science educators, but the conclusion appears inescapable.

The fault does not lie solely in the way science is taught in our schools, but also stems, I believe, from two related problems. One has to do with the role of science in our daily lives; the other with the double standard I mentioned earlier.

Paul Hurd has said that the mark of an advanced civilization is its ability to produce scientific and technological manpower. In these areas we do quite well. My earlier remarks were not intended to disparage this aspect of science education. Instead, I was concerned about achieving some measure of scientific literacy for the 90% or more of our students who are not science-bound.

The average person identifies pretty well with literature — after all, he can at least read it — or with art, music, history, social problems, etc. Even if he is not very proficient in these areas he can still participate in them in some fashion, either directly or as an observer — and these are the sort of activities that he is engaged with on a day-to-day basis. But not so with science.

The amount of scientific knowledge that he actually needs to get along quite well in our modern society is negligible. Probably our ancestors, living in more primitive societies, felt a stronger need to understand the workings of nature than do our contemporaries. And the same is unfortunately true of mathematics. Beyond the barest elements of arithmetic —

little more than counting, actually, — we make few demands on one's mathematical skills in everyday life. One does not normally read science or math for pure enjoyment, as he might read history or government or literature. So whatever science or math one is exposed to quickly falls to disuse, rather than being sharpened by continuous exposure.

The early 19th century poet, Samuel Coleridge, somehow forecast our present cultural gap — or perhaps he contributed to it — when he wrote in his **Definitions of Poetry:**

> "Poetry is opposed to science . . . The proper and immediate object of science is the acquirement, or communication, of truth; the proper and immediate object of poetry is the communication of immediate pleasure."

Surely this is the crux of the problem, for one could substitute art or music for poetry with equally valid conclusions. If science were somehow necessary or pleasurable to the average person it is difficult to imagine that we would now have a two-culture society.

This is but one of the problems we face. The other is the strange double standard we have which mitigates against scientific literacy as a cultural imperative. This double standard is easily seen on any university campus, my own included. My humanist colleagues would consider me quite illiterate were I to have no acquaintance, say, with the work of Shakespeare. Yet they do not expect me to think any less of them were they to profess ignorance of the work of Newton or Galileo. It was not uncommon some years ago to find humanities professors who openly declared their ignorance of science as though it somehow increased their stature as humanists. Today it is no longer fashionable to profess such ignorance, but the fact is they are no more literate in science now than they were a decade or two ago.

Snow gives a rather good example of this double standard. Imagine a scientist present at a gathering of literary intellectuals, and perhaps to make conversation he asks how many of them could describe the Second Law of Thermodynamics. Now this might seem quite unfair and is bound to evoke a cold response; yet according to Snow he would be asking something which is about the scientific equivalent of, "Have you read any of Shakespeare's works?"

Perhaps the question is a bit too sophisticated. But if he were to ask a simpler question, such as . . . "What do you mean by mass, or acceleration?" which is about the scientific equivalent of saying, "Can you read?" Snow points out that probably not more than one in ten of these highly educated individuals would feel comfortable with it.

Sometimes I have the impression that there are those among my colleagues in the humanities who think that if they ignore the scientific revolution it may quietly disappear. What is so depressing about the situation is that this attitude finds receptive ears among students who are unwilling to devote their time and mental energies to a demanding scientific discipline. We have more humanists on our campuses than we have scientists, and we have many more students in the humanities than in the sciences. It thus become a self-perpetuating problem. Apparently many students fancy themselves potential poets or artists, but few entertain such ambitions toward science. And as the twig is bent, so goes our culture, to paraphrase Pope's famous line.

This must surely be one of the strangest contradictions of our time. On the one hand our way of life is largely determined by technology — our modern conveniences, our health, the basis of our economy, our ability to make war or to encourage peace — all are products of science. At the same time it is the most poorly understood of all the activities we engage in. It is indeed the "other culture" in the sense that while it may seem to offer all things to all men it actually means very little to most.

Let me now summarize our present status as I see it:

1) General education in science has been a great failure over the past half century or so if judged by the scientific sophistication of our educated adult population.
2) Science has moved so fast in the present century that it

has lost the humanist. More than this, science itself has lost the human touch.

3) Our double intellectual standard is a serious barrier to improving scientific literacy.
4) In the elementary grades, where children are most receptive to science, it is taught most poorly, if at all.
5) Either we must face reality and give up teaching science as a part of general education, or we must take drastic measures to change the existing order.

In my view it is worth taking whatever steps are needed to reverse this trend toward scientific illiteracy. The following measures are proposed as possible first measures toward this objective:

1) Completely overhaul the pattern of science education in the elementary schools. This means developing new and imaginative curricula which involve children directly in a "hands-on" fashion. A number of impressive steps have already been taken in this direction. But more such programs are needed. In particular, some group should try to develop an entire elementary curriculum which has science at its focal point and from which other learnings, such as mathematics, social studies and language arts, can be motivated and derived. The reason for this is very simple. Science is known to turn youngsters on, particularly if they are directly involved in the process. It is "culture-free" in the sociological sense; in science there are no disadvantaged children. Hence why not try to evolve an elementary curriculum about science rather than about the traditional disciplines? It seems to me well-worth an experiment.
2) Take elementary science out of the hands of the regular classroom teacher and adopt more widely the system of science specialists or consultants which appears to work so well. After all, we do not expect all teachers to be competent in music or art, why should they be in

science after so little exposure to it? This poses a challenge both to the teacher training institutions — to turn out some 10,000 specialists a year — and to the fiscal base of education, where the added cost would be about a half billion per year, an increase of only 2% in the salary budget of our nation's public schools. Now surely if public understanding of science is as important as we think it is, this is a small price to pay for it. In terms of other things we pay for, it is roughly 10% the cost of our space program (NASA).

3) Science courses in general education must be humanized. The enterprise should be shown as a lively, human activity — not a dull collection of facts. Get rid of all trivia and unnecessary detail. Concentrate on the major ideas and on their influence upon man's intellectual development. One really does not need to touch upon every facet of a discipline in order to convey its flavor. In fact, it is probably just this tendency toward minutiae that leaves students unable to see the "forest for the trees."
4) Remove the pressure of grades from high school students so that those who wish to can take challenging science courses in a relaxed atmosphere without having this constant threat hang over them. I propose that this be done through some variant of the Pass-Fail Option which is now gaining popularity in the colleges. For instance, students might be permitted to elect one course each semester in which they would be graded only as to pass or fail, and these grades would not be included in their overall average. The option could be exercised in any field, of course, but I suspect that its major use would be in science.

It should be evident from the foregoing that serious thought must be given to the problem of general education in science, else what is now merely the "other culture" will in due time become the lost culture!

Flight No. 25

MOKE WAYNE WILLIAMS

Your flight will have a slight delay from the time of intake to take-off. The delay is usually twenty to sixty minutes. As you take off, you feel flushed because of increased blood pressure, and your heart beats faster. Your hands have a slight tremor. You want to reach for sunglasses because the light annoys your dilated pupils.

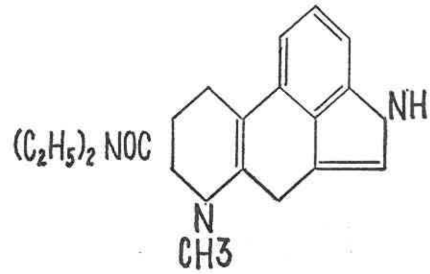
When you gain altitude, it seems as if time stands still. Colors fascinate you. Wonder and bewilderment at design or interpretation of familiar objects begins. The television set disturbs by its insistent infringement on your privacy; it is spying on you. The friend across the aisle suddenly isn't your friend, but your boss who fired you from your job a few years ago. The necessity to exorcise your hostility becomes obsessive. Chairs and lights change shape and meaning.

If your flight is a high altitude one, you have reached a level of different self-evaluation. You are blessed with mystical powers of will and insight. You view yourself as a formless mass merged with all the universe. Sudden comprehension of unknown and hidden meanings are yours. Excitement and exhileration are supreme. Sounds are intense; a button brushed against the metal chair arm clangs to the point of pain.

Along your flight, your body moves differently. It is more tense, and your jaws may have begun to ache. You cannot speak because of the muscle spasms in your face. Even though you are highly spirited, you have a sense of fatigue and a desire for "landing" becomes an awareness. Your flight, however, will last six to eight hours and may continue for forty-eight hours.

This flight has been through the use of non-conventional aircraft. It began by first taking, usually by mouth, a potion of LSD. D-lysergic acid diethylamide is derived from ergot, Claviceps purperea, a fungus growing on cereal grains, also semi-synthetic. It has the chemical structure:

Moke Wayne Williams is a psychiatrist in private practice with the Lauderdale Psychiatric Group which he founded. The research project as described conducted at the New Jersey Neuropsychiatric Bureau of Research included a personal experience by Dr. Williams. The experiment was conducted with the supervision of an observing physician and nurse with the use of 500 millimicrograms of LSD orally ingested. From this experience, Dr. Williams has drawn some of the information for his description of LSD effects.



LSD is the most potent of known hallucinogens. Effects of d-lysergic acid diethylamide (LSD-25) was accidentally discovered in 1943 by a Swiss chemist, Albert Hofmann. Since that time, studies in experimental and clinical medicine revealed that the plant sources were familiar to ancient cultures and societies — the Vikings, Aztecs and certain tribes of the North American Indian employed the drug. Usually their usage of the drug was related to specific rites such as religious ceremonies or to rituals to induce desired warlike moods.

Most recently, certain scholars have considered LSD-25 as an important aid in man's efforts to achieve greater understanding of himself and the world he lives in.

Presently, LSD must be analyzed in relationship to therapeutic psychic value and use, its abuses and dangers.

As mentioned above, an expounded well propagandized concept of this effect of LSD has heralded widespread use of the drug. The publicity attended growth of popular cults advocating use of this hallucinogen to "expand consciousness" and "improve the mind." In the "take it for kicks" groups, the pleasure is seemingly derived from the startling hallucinations or for escape from a routine and ordinary existence.

The danger associated with the indiscriminate and illicit use of LSD is essential to consider. Prolonged psychotic episodes have developed, as well as extreme anxiety and panic reactions. The danger lies more in reducing emotional and affective controls and in inducing a "persistent state of altered consciousness." Therefore, the danger of adverse reactions appears greater in emotionally unstable and psychopathic persons, and these are precisely the individuals who are attracted to the use of LSD.

To emphasize the psychic effects, the most significant symptoms are distortion of sense perception, visions, pseudohallucinations, and hallucinations, dreamlike thoughts and dream images, and depersonalization. Emotional reactions are usually present and vary from euphoria to depression, with mood changes frequently occurring during the period of intoxication. The type of emotional reaction appears to be influenced by the dosage of the drug, the basic personality of the individual, and the setting in which the drug is administered. Following use of LSD, the phenomenon of reappearance of hallucinations and depersonalization may occur weeks or months after stopping the drug.

During a ten month period in 1965, a total of 65 persons were admitted to the psychiatric division of Bellevue Hospital in New York City with acute psychoses resulting from the unsupervised use of LSD. Of this group, 52 case records were examined carefully. The average age was just over 22 years. Overwhelming fear, uncontrolled violent urges, and strong auditory hallucinations were predominant manifestations; two of these patients had attempted homicide. Twelve patients appeared to have underlying psychoses or schizoid personalities. Of the 52 patients, 30 recovered in less than 48 hours and an additional 11 within a week. In 6 patients, psychotic manifestations persisted for a prolonged period, and of these, 5 required long-term hospitalization.

Therapeutic uses for LSD have been and continue to be under study. In 1962 at the New Jersey Neuropsychiatric Institute at Princeton, New Jersey, a study involving ten volunteers from the Bordentown Correctional Institution was made. Standardized psychological tests were employed to measure, specifically, perceptional changes of both external and internal types. Other devices designed to evaluate LSD effects consisted of observations of group behavior and activity. Projection self-portrait transparents were employed as a stimulation device. The subjects were required to attempt to sketch their impressions of their physical characteristics and to submit a brief narrative self-description of their personality characteristics. The doses were variable with some of the subjects receiving placebos. All LSD administrations were within blind study requirements as nearly as possible.

Resulting from this study, no definite conclusions could be determined. Generally, the impressions were that external perception was first distorted and then an internal perceptional effect was seen. The internal perceptional changes pointed out prominently the possibility that more comprehensive understanding of one's self is conceivable. It was concluded that a definite therapeutic use of LSD within the psychiatric field could be possible. There have been favorable reports on the value of LSD in treating psychiatric conditions, especially those resistant to conventional forms of psychotherapy.

LSD and mescaline have been reported as effective in treating chronic alcoholism, with remission rates of about 50 percent. Similar claims have been made for the success of these drugs in the treatment of the chronic neuroses, and LSD has been suggested for relief of severe pain in patients with terminal malignant diseases. Reports of "dramatic improvement" of patients as a result of using hallucinogens have been challenged on the grounds that such claims are not based on precise, detailed, controlled studies. Much additional research under strictly controlled experimental conditions is needed.

SUMMARY: D-lysergic acid diethylamide has been historically reviewed and special note made of its present day state. An attempt to evaluate LSD-25 in view of its abuse as well as its possible practical application has been made. It is obvious that legitimate research in depth is necessary before knowledge permits intelligent utilization.

Editor's Page

JOSEPH GOLDEN, in a book review in this issue, in the course of what he has to say about the theatre in America, makes some strong remarks about the alienation of art from experience in our people. His words are hard for many of us to swallow. The first reaction of most Americans is resentment at such a condemnation of American culture. (These condemnations are many. I remember a friend of mine who served as Cultural Attaché in a country with whose traditions ours are closely bound, remarking how unbelieving people reacted when he said he was a cultural officer from America.)

Then resentment turns into rebuttal. Figures are quoted to prove our traffic with the arts in this country is dense. We point to the number of symphony orchestras and art museums we have, the business we do in books and records. But the hard truth is that these statistics about the number of symphony orchestras per square mile or the number of classical records sold per square head do not answer the kind of criticism Dr. Golden and so many others make.

The involvement of most Americans with the arts is still for entertainment, or edification, or social acceptance. We think of a museum as a repository of the great art of the past where one goes to passively look and admire and escape from the world. We flock to pretty musical comedies because they are always charming and never offend us.

Actually, the arts as part of one's experience mean involvement in the world about one. They must be forward looking, not backward looking. The dynamic musical organization is one that leads its listeners into new sonorous intricacies and explores the potentialities of new materials. The lively museum is one that leads us through new aesthetic constructions to adventure in the qualitative possibilities the world opens up to us. The arts are a way of exploring the world through our sensibilities.

The arts are research in their way just as science is in its. They push out the frontiers of our sensibilities; science extends the frontiers of knowledge.

In any university dedicated to research the forward development of the arts and their techniques has a legitimate place. The new university of the future in America cannot be for the arts, or for the humanities, what it has been in the past, solely a depository and transmitter for the traditions of the past. For a healthy art, as for a healthy science or a healthy society, the past is prologue. When the university shifts its emphasis in respect to the arts and humanities from appreciation to involvement, then it will have brought these out of the ivory tower into the world as we experience it.

Nova University will some day in the not too distant future add to its research and educational programs work in the arts and the humanities. And the way it does this must give vital impetus to the role of these endeavors in our lives.

C.E.G.

Book Reviews

Golden, Joseph. **The Death of Tinker Bell,** Syracuse, New York, The Syracuse University Press, 1967, pp. ix — 181, $5.00.

This is an interesting and informative book about the American theatre for the playgoer and theatre lover. Did I say about the American theatre? I mean, rather, about the failure and hope for an American theatre; for, as the author says, ". . . the American theatre itself does not exist." (p. 134.)

Tinker Bell is the symbol of the sustained vision, imaginatively held, of the theatre as it might exist in America, as a great art. This Tinker Bell which has died probably never existed, for "art as a natural and native experience . . . is alien to most Americans; . . . it is very much divisible from the common fund of the American experience; . . . it seems something of an afterthought." (p. 25)

The ground has not been fertile for the theatre in America. There have been the long-standing Puritan suspicions of the theatre and the actor, the pressures of the commercial stage, and the belief that the theatre should moralize. Dr. Golden's autopsy on Tinker Bell is unsparing but without rancor.

He then examines the work of O'Neill, Maxwell Anderson, MacLeish, Wilder, Tennessee Williams, and Arthur Miller to show where they have succeeded and where they have failed in their attempts to remedy our dramatic blight. He shows why the return to the Greeks has not been a solution, why realism has failed, why the hero has diminished as hero, and why attempts to invoke the poetic voice have been unsuccessful. His chapter on the fate of the poet in America is most interesting: the poet cannot breathe here; he is too dangerous for our society of stable values. In Wilder, Williams, and Miller he finds three dramatists who believe man as a rational creature is ultimately justified, and who have the guts to show the hell man must pass through to reach that rational condition.

He sees hope for the theatre in America. There are positive signs in the spread of professionalism, greater opportunities given to new playwrights, and attempts to close the gaps between the commercial and the university theatre. There are some weak signs in our poor support, but some support, of community and children's theatres. And there have been anti-signs in such things as the theatre of the absurd, the theatre of cruelty, and happenings, as well as 'method schools' of acting, in their various ways of attacking tradition. In my opinion these anti-signs are more positive in some respects than Dr. Golden seems to think. There can be significant drama without the basic concept which Dr. Golden embraces as the necessary condition for the art: that a "discordant universe" must be brought back into "some form of harmony." But this contention is one the general theatregoer might disagree with.

This book is highly recommended. Dr. Golden is a man of definite convictions, a trenchant critic and an engaging writer.

C.E.G.

Jones, W. T., **The Sciences and the Humanities,** Berkeley and Los Angeles, The University of California Press, 1965, pp. ix — 282, $6.50.

This book attempts to heal the schism of the two cultures, to reconcile the conflict between the sciences and the humanities. If science deals with facts and is our best means for discovery of the world about us, then our great cultural problem is to find a place for value in this world of facts: such is the way the problem is usually put. Professor Jones' approach to the problem is strategically different. Eschewing the old idea of a single reality which minds strive to know, the author begins with the assumption that minds and objects are interrelated structures within experience. Thought is the process of reorganizing a "foreground" by means of a "background" structure when a former interpretation has broken down. The type of behavior which responds to and expresses various needs of an organism as it operates in its environment is language. The sciences and the humanities are thus various languages. Each is explanatory and expressive, for there is a mixture of cognitive and non-cognitive elements in all languages. It is not correct that scientific language is solely cognitive and the languages of the arts is solely expressive. Consequently there is a plurality of realities each of which is relative to and expressive of some basic attitudes and needs, and the world experienced through the sciences is a construction as much as the world as experienced through the arts. Accordingly, the world as disclosed through the sciences is neither more nor less real than if disclosed through the arts, and the converse is equally true. If a person lives in one to the exclusion of the other he simply reveals a preference for a certain sort of values and deprives himself of a complimentary range of experience he might otherwise enjoy.

It has always been the opinion of this reviewer that the over-emphasis on a dichotomy between the sciences and the humanities has been unfortunate. The two cultures are not diametrically opposed; they have some aspects in common. However, making clear what these similarities are is a task that is not so easy as it may seem. It involves long considerations of the functions of language, the processes of thought, our attitudes and actions about the world, and about the functions of the arts and the sciences themselves. It involves a whole philosophy of human knowledge and expression, the adequacy of which philosophy can only be judged by the greater comprehension it provides us about the actions we call science and art. Professor Jones has suggested a fresh approach and has tackled the many problems in a way that should command our careful consideration.

C.E.G.

Jaki, Stanley L., **The Relevance of Physics,** Chicago, The University of Chicago Press, 1967, pp. 608, $12.50.

It is interesting to note that Stanley Jaki, professor of the history and philosophy of physics at Seton Hall University and a visiting member of the Institute of Advanced Studies at Princeton, is a Catholic priest and a member of the Benedictine order, and has doctorates in both theology and physics.

The title of this book is scarcely revealing. A better one would be "The Relevance of a Knowledge of the History of Physics for Understanding the Function of that Science." Father Jaki's message is nothing original but for the general reader it is most informative and knowledgeably done. I recommend that one begin with the final chapter where his thesis is summed up: science does not give any absolute truth, nor it it based on incontrovertible facts; it gives probabilities and inches laboriously toward absolute truth and perfect accuracy. Its findings are not philosophically inescapable.

Many of these contentions when precisely specified as to their meanings, are within the usual admissions of science, though sometimes it seems Father Jaki overstates them in a way that goes beyond such careful specifications. It is probably good, however, to have someone point out again the error in any innocent beliefs in the ultimate finality of scientific truths.

Science does have humanistic aspects, Father Jaki says, and a study of the full history of science, with its errors as well as its triumphs, with its occasional posings of finality, with some attention to the basic models underlying its explanations, will uncover those aspects.

The first part of the book inspects the three prominent world models of physics: that of Aristotle and the ancients who thought of the world as an organism, that of the post-Renaissance centuries which saw it as a mechanism, and the new model of the present where the world is handled as a pattern of numbers. We have learned the suggestiveness and the limitations of the first two models, says the author; and he confidently predicts that the mathematical concept of physics will no more make an exhaustive explanation of nature than did the two former ones, for "numbers depend on the concreteness of things instead of generating them" (p. 116). I think every good present-day scientist admits that we do not expect to exhaust the intelligibility of nature, but he does see that with the present model he has one that will carry his investigations and understanding to greater comprehensibility than the former ones before it shall in its turn give way to an even more suggestive and more embracing one. This refrain of the incompleteness of our scientific knowledge, of the folly of any hope of achieving an all-inclusive explanation is repeated for every general branch of physics, whether it be the study of the "layers of matter" of the sub-atomic world or of the vast reaches of space, or the drive to precision in measurement.

Sometimes Father Jaki is calling attention to the errors and posings of finality in the history of science not so much for showing us that science is beset with humane limitations, but for clearing the way for a "summa theologica" where science would be put in its "proper" place. In the second section of the book the relations of physics to biology, metaphysics, ethics, and theology are treated. In relation to biology Father Jaki declares theological concepts are indispensable and are no more irrational than the quantum in physics, though just as unfathomable. Though this may not be a false statement it is not necessarily a true one. It seems a rash one. In discussing metaphysics the author admits, of course, that philosophical speculation will not take the place of scientific investigation in describing the natural world and that, insofar as that is what traditional metaphysics attempted to do, it is unjustified. Then he proceeds to show how there are metaphysical assumptions about the efficacy of one's methods, and working assumptions. Undoubtedly there are such kinds of assumptions outside of and prior to the scientific work itself; but these are working assumptions and not metaphysical in the old sense. Their relation to science is part of the business of the philosophers of science and is recognized as such by scientists.

In relation to ethics he says there has been a gradual encroachment of the quantitative upon the qualitative aspects of existence. Not enough consideration is given to realities that science disregards; to sin, to love, to hope, to compassion. True, he does discuss the attitudes of those engaged in developing the atom bomb during World War II. That in itself, and the subsequent concern of the scientists with the ethical implications of technological development, should be evidence that the two aspects though different are enmeshed. The real question is should ethics be left to the ethicians and the religionists? Have they given us anything definite to go on without being dogmatic? Or may we hope for a fresh consideration of ethical problems from those who see the ethical problems as part of the general technical problems they are faced with to solve?

In respect to theology the book even has some discussion of miracles. The author objects to the idea that a scientist's scientific training, not his philosophy, makes it impossible for him to accept miracles. Scientific training, he says, only allows us to distinguish the "toadstools" from the miracles! I ask, do we need deal with such questions in a book about physics?

Any reservations are unimportant, however, if one gives his attention to this book as a splendid history of the triumphs and limitations of the humane inquiry called physics.

C.E.G.

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