tion. The library's success in using automation for bibliographic control of medical literature suggests that other disciplines that have not already developed automated techniques of literature-reference retrieval might profitably do so.

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Thoughts on Research

Curt Stern

The joys of the investigator have often been sung. The ecstasy which led Archimedes to rush from the bath into the street, naked and shouting "Eureka" (I have found it) has been felt by all discoverers even though their restraint in exhibiting their ecstasy made it less memorable.

To perceive a fact of nature which had never been seen before by any human eye or mind, to discover a new truth in any field, to uncover an event of past history or discern a hidden relation, these experiences the fortunate bearer will cherish throughout his life. But let the pains of research not be overlooked. Hardly has the new discovery been made when its author begins to question its validity. How the heart can seem to cease beating when a loophole is perceived! In such a moment the heaven-high jubilance of the discoverer turns into deathly sadness. And it is not sickly indecision which brings this sudden despair; rather it is the investigator's task to doubt and to doubt again.

Many supposed discoveries wither under the impact of such critique. Some, however, will finally withstand all tests. Now new questions arise. What is to be done next? Can one pursue further the lead which brought success, or has success itself closed the avenue to continued harvest in its area? Should one start somewhere else, and what are the chances that important insights will be gained in the new field?

"Knowledge is like a sphere in space" wrote Pascal, "the greater its volume the larger its contact with the unknown." This may indeed be true but contact with the unknown is not enough. It is of the essence not just to ask questions but to ask the right ones. There is rarely an answer to wrong or vague questions. No biologist has approached his subject successfully when he began by asking "What is life?" He did succeed in a more modest way when he posed such questions as "What is the chemistry of fermentation?" or "How does water ascend a tree?" New discoveries can be the end as well as the beginning of a period of research. Pascal's beautiful analogy has an ugly counterpart in another analogy, that of a piece of wood inhabited by termites, the wood representing the problem and the insects the researchers. When the termites have reduced the log to dust the problem is solved—and the search for another log may be long. Thus many physicists of the late 19th century felt that they had essentially solved the problems of their science and that little remained to be done. It is a happy thought that unexpectedly they became challenged again by the discoveries of radioactivity and x-rays.

Knowledge grows by the rare findings of great importance as well as by the accretion of minor ones. Unfortunately many minor findings do not simply add up to one major. Major and minor are labels which derive not from the facts or concepts themselves, but from their significance to the whole. Theodor Boveri, the great biologist, once wrote as follows: "The significance of a discovery is determined much less by its specific achievement than by subsequent investigations which show whether the validity of the findings is narrow or wide or even all-embracing."

This significance cannot be foreseen. Here the course of science resembles that of evolution. It may be pictured as an exploration of an unending series of mountain chains. When you enter a new valley you cannot know whether it will end blindly or lead to a pass through which one may reach a vast new area. There are few passes and many dead ends. Many species become extinct without having evolved into new ones. Those in existence now are the descendents of the few who happened to cross the barriers. Man himself had a very narrow escape from never coming into existence. If it is true that most explorations by investigators and species do not lie in the line which leads to the future it follows that the reward of such explorations is limited.

There are some fortunate minds whose fertility gives them an ample supply of new ideas. Yet, it is human fate that time passes on, and the river of knowledge is mightier than the mightiest single mind. Rarely do the later ideas of even the great possess the relevance of their earlier thoughts. And what of the less fertile minds who,

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when granted success, tremble in fear of future failure? And what of those intelligent and able seekers on whom fortune has not yet smiled? It is easy to recognize in given instances how luck favored the prepared mind. But the prepared mind is not always favored and no one knows how often the constellation of preparedness and luck occurs.

It is not surprising that many researchers fall by the wayside, some who were not given the revelation of discovery and others who did experience it. There are great artists whose spring of creativity became dry too early and who spent a lifetime of being living fossils. There are investigators of renown who outlived by decades the period of their accomplishments. Courageously, some men will by an act of decision terminate early or in middle age their search as investigators. They may weigh the unknown prospects of gain against the certain sacrifices of leisure, breadth, and peace of mind. Coolly, they will compute the probability of future research gains and, judging this probability to be low, devote themsleves to teaching alone or to administrative tasks. Often their former colleagues or their younger successors look down on them. "He doesn't do any work any more" is a familiar, cruel comment. But why not permit the honesty of the insight that to create is a hazardous undertaking? He who has tried it has also the right to choose a task where, as a teacher, he can recreate knowledge and attitudes, or where, as an administrator, he can apply his thoughts to the prerequisites of research and teaching. Perhaps he will be able to enjoy the leisure, breadth, and peace of mind whose lack he regretted in his research days. Perhaps he will continue to miss them.

Of course, different men leave research for different reasons. Some give it up reluctantly, but in the knowledge that they can at times be particularly useful in some other capacity. They may fulfill their new duties for a period of time, and then, having carried them to success, return gladly to their original pursuits. Others may even be able to be administrative leaders as well as, simultaneously, investigators. But for these too, it is valid to say: Carrying out research begifts and deprives.

We tend to admire the man who once having elected a field of study remains with it throughout life. We call him faithful, speak admiringly of his patience, and say that he devoted a lifetime to his specialty. However, what distinguishes his faithfulness from that of a lifelong bookkeeper, his patience from that of a housewife, and his devotion from that of a philatelist? It may be true that the social significance of the scholar's work is greater than that of many other individuals, but is his own personal significance exalted?

Let us therefore be candid with those who want to become investigators. Do not be blinded, we must tell them, by the glamour which is only one aspect of a research career. Be prepared for disappointments and the feelings of failure. But also do not imagine that your own periods of distress are unique. Few of those who seem to have sailed serenely on favorable breezes have not experienced their wind-still periods.

The scientific career has been called a carnivorous god. Perhaps more appropriately it may at times appear a soul-devouring god. However, by no means does it need to take on this aspect. Whatever dangers personal weaknesses and social pressures may present to the investigator, he can rise above them. He can retain the enthusiasm of youth which led him to contemplate the mysteries of the universe. He can remain grateful for the extraordinary privilege of participating in their exploration. He can incessantly find delight in the discoveries made by other men, those of the past and those of his own times. And he can learn the difficult lesson that the journey itself and not only the great conquest is a fulfillment of human life.

News and Comment

Security Practices: Nonmilitary Agencies Still Hold to Vestiges of Procedures Developed in 1950's

During the past few years, federal agencies have modified or eliminated many of the security regulations that grew out of Senator McCarthy's allegations about Communist infiltration of government activities. But vestiges of the old-time regulations still remain, even in such benign agencies as the National Science Foundation and the Department of Health, Education and Welfare. And although it is not generally realized, the security regulations apply not only to full-time employees of the agencies but also to persons who are invited to serve a few days each year on the panels and study sections that evaluate research applications.

The current regulations and the spirit with which they are applied are considerably less stringent than they were in the 1950's, when federal agencies tended to protect their political flanks by playing it safe in doubtful cases. But the policy of imposing security procedures in nonmilitary areas still grates on many persons, especially when they learn that all consultants must sign a loyalty oath and a disclaimer of disloyalty which states, in part, "I am not a Communist or Fascist," and that many of them must undergo what is called a National Agency Check, which involves a search for information about them in the files of the FBI, the Civil Service Commission (CSC), and the House Un-American Activities Committee. (If they are veterans, the search extends to military intelligence files.) Until recently, all HEW consultants were fingerprinted; many still must submit to this requirement, but the Department is attempting to work out procedures that would exempt most of its consultants from fingerprinting and from the National Agency Check.