STRAIGHT AND CROOKED THINKING

If we observe the actions of men, whether as individuals or as groups, and whether scientists or non-scientists, we find that they frequently fall into avoidable errors because of a failure to reason correctly. There are many reasons for this, though only a few can be dealt with here.

The first difficulty is bound up with (related to) the use of words. It frequently happens that what one person means when he uses a certain word is different from what others mean. Consider, for example, the words *intelligence*, *oxygen*, *accurate* and *average*. In *intelligence*, we face the problem that a word may not mean only one thing, but many- in this instance a very complicated set of aptitudes and abilities whose numbers and characteristics are not agreed upon by the specialists who study the phenomenon, and are even less understood by the layman (nonspecialist). In *oxygen*, we have a different problem, for although both; a research chemist and a chemical manufacturer identify the word theoretically with the element O, in practice they have different concepts about it. Thus, if the researcher performed a delicate experiment, using the manufacturer's *oxygen*, it might easily be a failure since the so-called O, whether used as a solid, liquid or gas, would almost certainly contain other substances. Hence another difficulty about words is that they often do not differentiate clearly enough between several varieties of the 'same' thing.

Another common error connected with words consists in confusing a word or a name with a fact. The course of scientific progress has been frequently slowed down by (1) assuming the existence of *something* to account for a certain phenomenon, (2) giving the assumed substance a name, e.g. *phlogiston*, *aether*, etc., and (3) implying that the phenomenon has been satisfactorily accounted for (explained).

Apart from the misuse of words, mistakes in logic can occur. Thus an example is recorded of a young sociologist, investigating literacy in a certain community, who discovered from the official records that over (more than) 50 percent of the population were females. He subsequently found that approximately 70 percent of the population were literate. When he had obtained this data, he summed it up and drew conclusions as follows:

Most of the population are females;

Most of the population are literate;

$\therefore$ most females are literate.

This was, of course, an unreasonable inference, as the investigator himself realized as soon as he had re-examined his chain of reasoning more carefully.

Another mistake is to confuse cause and effect. This may easily occur at the beginning of an investigation, but if it remains uncorrected it can be considered as primarily a by-product of insufficient experimentation. To illustrate this, the following case can be quoted. The inhabitants of a certain community had noted over the ages that whenever an individual became ill with a fever, the body parasites left him. They therefore made the correlation that the parasites kept them healthy. Later, however, properly controlled scientific investigation showed that the reverse was true: in fact the parasites transmitted several kinds of fever, and then left the sick persons when the latter's bodies became too hot to live on.

Some other factors which may influence reasoning are (a) faulty analogizing, (b) the inhibiting effects on further research of concepts which have been widely accepted as satisfactory, (c) the role of authority as a bar to the re-consideration of a problem. As regards the first of these, it should be emphasized that the process of tackling one problem by analogizing from another has frequently yielded valuable results, as in the case of air-pressure (see Unit 3). On the other hand, it may lead to the adoption of a totally false hypothesis, as when the idea of the atom as an infinitely small piece of solid matter was obtained by

analogizing from the world of visible appearances. This erroneous viewpoint blocked progress in this field for many decades. Similarly, the comparison of the movement of light to a wave -an analogy which had actually provided a satisfactory explanation of the observed phenomena during most of the nineteenth century tended subsequently to interfere with the development of the equally valid concept of light as a stream of particles. This example also illustrates the second factor enumerated above. As far as the third factor is concerned, the history of science shows many instances in which the force of authority has operated in such a manner as to build up an exceedingly powerful resistance to further investigation; in some cases centuries elapsed before this resistance was eventually broken down, as happened in cosmology, for example.

Thus, in addition to the chances of going astray outlined in the previous unit, the scientific investigator shares with the ordinary citizen the possibilities of falling into errors of reasoning in the ways we have just indicated, and many others as well (in addition). The more he knows of this important subject, therefore, the better equipped he will be to attain success in his work; and the straighter he thinks, the more successfully he will be able to perform his functions as a citizen.

Comprehension

1. Why do people make avoidable errors, and what sort of people make them?
2. What is the first difficulty connected with the use of words?
3. Give an illustration of this difficulty.
4. What has often been the result of the process outlined in II.26-31? What error does this process illustrate?
5. What evidence did the young sociologist find to support the assumptions set out in II.39-41 ?
6. What conclusions (about his inference) did lie come to as soon as he had re-examined his chain of reasoning?
7. In a certain community, when were the body parasites observed to leave a person?
8. What inference did the people draw from this? What was the correct explanation, and what error in reasoning does this illustrate?
9. Name (i) a favourable, (ii) an unfavourable example of the value of analogy in scientific research.
10. Name two other ways, mentioned in the passage, in which the reasoning process can be adversely affected. Give examples of each.
11. What advantages can an awareness of possible errors in thinking bring to the investigator?
12. Give other words or expressions which mean approximately the same as: non-specialist; more than; to be related to; to explain; as well.

Short questions

A. What are the difficulties connected with the word 'average' ?)To clarify this you may have to find out the meaning of the words mean, median and mode and refer to book on statistics)

B. Write paragraph on organization pattern of this passage.

C. Justify the suitability of the title 'straight and worked thinking.

3. Long/ Discussion questions

A. Discuss the following, and explain the error:

Education implies teaching, teaching implies knowledge, knowledge is truth, the truth is the same every where. Hence education should be the same every where

B. Give examples from general science or from your own discipline, how misunderstandings and errors can be caused by words.
C. How can we prevent ourselves in thinking in crooked way, and think in straight way?