

British Association—Exeter, 1969

Bread and Circuses

THE year just past has been dominated by the Moon, and the chances are that the next few months will be similarly preoccupied. It is, after all, an exciting and even an important adventure. But no cost-benefit analyst worth his salt would pretend that the expedition is justified by its tangible results. To know a little more about the surface of the Moon, and eventually a great deal more about the internal structure, will be of great interest but it will not suddenly transform anybody's understanding of the Solar System or its evolution.

A visit to Mars by people, on which the United States National Aeronautics and Space Administration seems to be setting its heart, is likely to be equally indecisive. The trouble is, of course, that the progress of science depends not on the right answers to questions chosen at random but on constructive answers to questions which are almost certain to produce illuminating replies. In science, in other words, the skill lies in asking the right questions. Although the visit to the Moon has been interesting and will, with its successors, provide the answers to a number of questions, nobody would pretend that, in terms of science, these were the questions with the highest priority when President Kennedy declared, in 1961, that the United States would hurry off to the Moon. This may be why there has been a sense of let-down, since the landing of Apollo 11, among some of the Apollo enthusiasts. Great things have been accomplished, but they seem almost like disappointments.

It is true, of course, that the journey to the Moon is not justified entirely in terms of the possible benefits in science which it may bring, and, to that extent, it may seem churlish and even unwise for scientists occasionally to grumble about the cost of the Apollo programme and to imply that it would have been better to spend the money on other things. To say that the arguments now being made for a journey to Mars are even more mistaken, however, does have a foundation in science. For the chances are very high that a landing on Mars by the United States in 1982, the earliest date possible, would yield much less benefit to science than the expenditure of a mere fraction of the cost on other kinds of enterprises. But may not a journey to Mars be justified by the techniques that would be developed in the process? Even here, such benefits as are within reach could probably be attained more cheaply and more certainly by other forms of expeditions beyond the atmosphere. In other words, it is a kind of public service to resist the expedition to Mars.

The long debate in the United States and elsewhere about the priority which should be given to the Apollo programme and its elaborations has been marked by a strange reticence in the scientific community. The doubters have tended to wash their hands of the affair, saying that science plays only a secondary part in the enterprise. The enthusiasts, on the other hand, have not yet been able to stamp the programme with a

sense of the order of priorities that would have been suggested on the grounds of scientific benefit. Although, in the past months, there have been signs of a welcome willingness among the planners of these expeditions to ask seriously what the objectives are, there is plenty of room for a greater awareness of the scientific benefits which a rounded programme of space exploration could bring.

There is, after all, no shortage of good causes on which money could be spent. The pages which follow show not merely some of the benefits of expeditions beyond the Earth but also some of the opportunities which lie nearer to hand. The topics which are represented in this survey of recent trends in science are by no means intended to include everything of current interest. Rather, they reflect some of the personal interests of the staff of *Nature*. They do, however, show that the progress of science is at once as rapid and potentially as subversive as it has ever been. In all kinds of fields, from astronomy to genetics, there is no knowing where the next discovery will set people's minds alight. There is even a kind of unpredictability about the benefits in applied science which may flow from some of the recent developments in pure science. Who knows, for example, what may come from Professor H. Harris's work at Oxford on the repression of malignancy in cells containing two sets of chromosomes, one normal and one potentially malignant, or what new departures may stem from work on reproductive physiology?

This is why it is unfortunate that in the past two years there has been what seems to be an international reaction against academic science. The unwillingness of young people to take up university careers in science, often exaggerated, is probably in any case a proof that scientific curricula are ripe for reform. The more serious cause for anxiety where the continuity of the flood of discovery is concerned is the way in which the enthusiasm of governments for supporting academic scientific research has failed to keep pace with the demand, as measured not merely by the growth of universities in the United States and most of Western Europe but also by the need of money to pursue enthralling lines of investigation.

CONTENTS

Bread and Circuses	...	...	...	...	1025
The Moon and the Planets	...	...	...	...	1026
The Crab Explained	...	...	...	...	1030
Continuing Excitement in Cosmology	...	...	...	...	1032
Geophysics made Respectable in Geology	...	...	...	...	1035
Cell Fusion: A New Gift to Biology	...	...	...	...	1039
Embryos outside the Body	...	...	...	...	1041