

devoid of much algal vegetation which is so necessary for *Chanos*. It may be added that the young prawns do not compete with *Chanos* for food and is hence widely employed subsidiary to *Chanos* culture in the Indonesian tambaks.<sup>15</sup> So far as the Indian Coast is concerned, what is required is an intensive collection and stocking of these penæids in the coastal waters which are otherwise unused by the successful combination of the principles of the prawn culture of the Malabar Coast and the *Chanos* culture of the Eastern countries.

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## SYMPOSIUM ON CYBERNETICS

A CHARACTERISTIC of the evolution of science in the present century has been the progressive intermingling of the various branches formerly considered as independent. This is especially true of the post-war years which have witnessed the emergence of the fascinating branch of study called cybernetics from the unification of the methodologies of the mathematical, physical and biological sciences. A Symposium on this subject was held on 31st January and 1st February, 1952, at the Indian Institute of Science, Bangalore. It was inaugurated by Prof. M. S. Thacker, Director of the Institute, who also presided over the Session the first day; Dr. J. Chandy of the Christian Medical College, Vellore, took the chair on the second day. The purpose of the Symposium was mainly to stimulate interest in the field and to have a discussion in which workers in different sciences could take part. With this in view, reports on the various aspects of cybernetics were invited from workers in mathematics, physics, engineering, neurology and psychology both in Bangalore and outside. The Symposium, the first of its kind in India on this new branch of science, was organised by the Bangalore Branch of the Association of Scientific Workers of India and its success was mainly due to the efforts of Dr. B. S. Ramakrishna, President, and Mr. N. N. Narayana Rao, Secretary of the Association. It is recognised that the greatest progress is likely to occur in those regions of science which are the

meeting points of established subdivisions and symposia of this type should therefore act as a stimulus in furthering research in these borderlands.

In his Inaugural address, M. S. Thacker pointed out that cybernetics, which considers the problems of control and communication in man and machine from a unified point of view, is a common field of investigation for scientists working in various fields. Thus, specialists in one field could place their intimate knowledge of their science at the service of other specialists and will in turn enrich their knowledge with what they can borrow from the others. On the practical side, cybernetics holds great promise to mankind, for instance, in the development of various devices which would help to replace one lost sense by another.

Opening the discussions, B. S. Madhava Rao dwelt on the scope of cybernetics and pointed out the fundamental role played by such diverse concepts as entropy in statistical mechanics and thermodynamics, feedback in engineering and even some aspects of mathematical logic in the terminology of cybernetics. The most important applications of cybernetics are in the field of neurology and rest on the hypothesis that the chief mechanism of the central nervous system is one of negative feed-back, which explains purposive and adaptive behaviour.

The next two papers dealt with information theory from the points of view of a communication engineer and a mathematician. B. S. Ramakrishna, who considered the former aspect,



discussed how the transmission of information can be studied quantitatively mainly as a result of the work of Wiener and Shannon. He indicated how the problem of communication through speech between one man and another can be discussed from this aspect and can thus become the object of study for acousticians, linguists, neurophysiologists and psychologists. V. R. Thiruvengkatachar's paper, which was presented by S. Dhawan, considered the time series nature of the messages transmitted in communication systems. It considered from the mathematical standpoint how best to recover a message which gets corrupted by noise during transmission and how to obtain an idea of the future of the message from the statistics of its past behaviour.

A set of three papers was concerned with the problem of feedback in men and machines and the manner in which they react to external stimuli. T. K. G. Menon and K. K. Nair dealt with the fundamental principles of feedback as met with in engineering, and pointed out how these could be applied to explain certain physiological phenomena. Such ideas may even be of possible use in explaining some aspects of social sciences. In the discussions which followed, Tischner indicated methods of determining the stability conditions of feedback systems. V. Narayana Rao spoke on the principles of mechanical servo-systems, their stability and their use in automatic tracking and remote control systems.

J. Chandy and B. Singh dealt with the cybernetic approach to the nervous system. The hypothesis that the mechanism here is analogous to the feed-back, scanning and servo-mechanisms met with in engineering is supported by the structure and function of neurones, Cajal's collateral and synapses. Proprioception, wakefulness and behaviour may thus be understood in terms of the above mechanisms occurring at various levels, i.e., spinal cord,

brain stem, cerebellum, basal ganglia and the cerebral cortex. Epilepsies may be due to derangement in the feed-back and scanning processes.

P. Srinivasa Rao explained how the general principles of instrumentation in machines are also applicable equally well to the sense organs of the living body. The main difference is that sense organs yield a combination of the instantaneous value and its time rate of change. He pointed out that in its reaction to external stimuli, the human physical motor behaviour is very similar to a servo-mechanism. The similarity between the functioning of the human brain and the working of machines like the modern automatic calculators was discussed by G. N. Ramachandran. He gave a description of the manner in which these machines work without any intermediate human aid and how they can perform many aspects of what may normally be termed "thinking".

M. V. Govindaswamy, taking the psychologist's point of view, said that although the cybernetical approach helps one in understanding some aspects of neurophysiology, the analogy between the nervous system and the communication system of the engineer is far from exact. He was of the opinion that although machines may be made to work in a manner similar to human beings, whether this approach can ever explain man completely is rather doubtful. The same opinion was expressed by J. Chandy. He pointed out that one must not conclude from the machine analogy that all neural and mental processes are essentially electrical in nature. In fact, the transmission of neural impulses at the synapses appear to be determined by the effects of chemical agents like enzymes.

Arrangements are being made to publish the full text of the papers presented at the Symposium.

### SULPHUR FROM SEA WATER

**A**LMOST sixty years ago, the interest in marine chemistry was great enough to render the idea of biological reduction of sulphates familiar to a few. Work over three decades on estuarial phenomena, Prof. Hugh Nicol claims,\* have shown that hydrogen sulphide can be re-

leased from the sea to any desired extent. The engineering difficulties in collecting the evolved gas may be considerable but there seems to be no relevant biological or chemical problem that cannot be tackled by present techniques, and the production of sulphur from sea water may prove to be no exception.

\* *Nature*, Nov. 24, 1951 p. 894.