

masters exist in two colleges only—Trinity College, Cambridge, and Christchurch, Oxford—the common practice elsewhere being for masters to be elected by the Fellows themselves. Each system has its merits and demerits, but the evidence from Trinity and Christchurch suggests that appointment by the Crown can be very successful, and it provides at least some guard against the 'safe' but undistinguished elections made at times under the other system.

It is no easy task to build such a complex organism as a Cambridge College from scratch, particularly when it is sought to blend science and the arts in a predetermined ratio. Recruitment of staff and selection of students both present their own problems, and a gradual building-up process will be necessary; but these difficulties are offset by the opportunity to break new ground educationally. In their original memorandum the Trustees laid particular stress on postgraduate training in science and engineering for both home and overseas students, and they emphasized the need to encourage men to return from industry for a period of study and research. The provision of laboratory facilities and courses for such purposes will be the task of the University departments of science and engineering, but, through its tutorial facilities and specialist Visiting Fellowships which it hopes to maintain, Churchill College can make a new and important contribution to the Cambridge scientific scene. Much has been said and written about the need for a closer welding of science and the arts in our system of university education. Churchill College has the opportunity to experiment in this field, too, and we may hope that under Sir John Cockcroft's guidance it will not be overlooked. For teachers we must have, and, if Churchill College can produce men to lead in teaching as well as in industry, then it will indeed fulfil the high hopes of its Trustees and of its many benefactors and well-wishers.

NEURO-MATHEMATICS

The Computer and the Brain

By Dr. John von Neumann. (Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xiv+82. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1958.) 24s. net.

THIS book constitutes the last writing to come from this eminent mathematician, a short account of whose life and last illness leading to his tragically early death in 1957 is given in a preface to the book by Klara von Neumann. The manuscript, intended for the Silliman Lectures in 1956, was never finished.

The first half of the book summarizes the characteristics of man-made computers. It distinguishes between analog and digital machines and the degrees of precision attainable in each, between parallel and serial methods of computation, between plug-board and memory-stored control, between active (arithmetic) units and inactive (memory) units, and discusses access times, memory capacities and so on.

The second half of the book compares the natural nervous system with artificial computers. It appears that the natural 'computer element'—the neurone—has a rather slow reaction time (10^{-2} sec.) compared with modern artificial devices. Von Neumann further implies that the method of transmitting information by digital pulse trains, interpreted in terms of pulse-time density to give digital-type logical information but analog-type quantitative information, will reduce the effective 'computing speed' by a factor of ten for each effective decimal place of accuracy. The loss of an occasional digit, however, would not be disastrous in the method of operation described.

On the other hand, he suggests that the effective memory capacity of the nervous system must be, and could plausibly be, of order 10^{20} decimal digits, in order to record a life-time of experienced sensations.

The overall picture is that the brain is, compared with modern machines, a very reliable and compact computer, with a low speed and a low order of accuracy in individual calculations, but an enormous (inactive) memory capacity, a large (active) arithmetico-logical assembly (highly parallel operation), and great economy in power requirements.

Von Neumann then argues as follows: since the brain has to control such a highly complex organization as the human body, it must carry out long (arithmetically deep) calculations. The brain cannot work to 10 or 12 decimal accuracy, which we know to be necessary in artificial computers, to retain two or three figure final accuracy. Hence, he argues that some different and unknown form of mathematics must be employed in the brain to produce its satisfactory results, and that conventional mathematics and brain-language stand in the same relation as an interpretive code to basic machine language, or vice versa.

In this connexion there are two relevant points, the first being hinted at by von Neumann himself, and the second, perhaps, being a point which he would have included in the book if he had been given time. First, the loss of accuracy at each stage of a long calculation may, perhaps, be eliminated by carrying out a large number of independent calculations at each stage, and evaluating the results statistically. By reason of its large 'active' assembly the brain would be well equipped to do this.

The second point is this: when planning a computation one has the choice between calculating everything *ab initio* (suitable for fast, small-memory machines) or using 'tabulated' results of earlier auxiliary calculations (suitable for slow, large-memory machines like the brain). The reviewer therefore suggests that the brain never does any arithmetically deep calculations—it merely makes minor interpolations, variations and extensions to a vast stock of 'tabulated solutions' which it has been accumulating (on a basis of trial and error and statistical selection) in its memory throughout the course of its development from a single cell. Really basic problems, like digestion of food and circulation of the blood, have perhaps been tabulated pre-natally for reference in this way. Slightly less basic problems, like learning to walk, have not been solved prior to birth, and it takes the infant's brain-computer many months to solve this problem. Even the adult's brain-computer may take a week to solve the rather simple problem of riding a bicycle. When obtained, this solution, or rather 'grid of experimental

results', is stored in the memory for future use by simple interpolation.

By bringing together two diverse bodies of knowledge—computer technology and neurology—the author wrote a most stimulating book, containing material for much further thought.

A. H. ARMSTRONG

SPECTRAL CASEWORK

Four Modern Ghosts

By Eric J. Dingwall and Trevor H. Hall. Pp. iii+8 plates. (London: Gerald Duckworth and Co., Ltd., 1958.) 15s. net.

THE first case concerns the repeated popping out of a book from a library shelf. In the authors' considered opinions the presence of a black nylon thread may have escaped the attention of the witnesses of the phenomenon. They then revive the late Harry Price's sensational story of how he visited an unnamed house and witnessed the most extraordinary séance ever vouchsafed a sceptical investigator. The living, breathing, talking figure of the little girl Rosalie materialized within a sealed room. The medium disappeared soon after, and the persons present have never been traced. The authors conclude, as have many others before them, that Harry Price, whose romancing propensities they exposed in a previous book, must have invented the whole episode. The third case is a typical poltergeist, with unexplained knockings and movements of objects at night, especially when two youths are about, and one member of the family said to have been caught by newspaper reporters in the act of throwing a book. The authors preserve "an attitude of suspended judgement". Finally they deal with bumpings, tremblings and noises in a house in Ousedale, and here they succeed in clearing the housemaid suspected of responsibility and placing the blame on subsidence due to subterranean water.

To quote the words the authors use of Harry Price, they may not have "advanced our knowledge of the supernatural in any way whatsoever", but they give a good display of professional zeal. The question looms large in their discussions whether their former collaborator, Mrs. Goldney, was once taken in by Harry Price. In reference to the Society for Psychical Research, they comment mildly in several places that, until recently, no discussion of the seismic theory of haunting noises has appeared in the Society's publications, but they quote an ancient letter to *The Times* describing the Society's methods of investigation as fit to "provide contempt in Bedlam itself". In an ingenious juxtaposition of sentences they say that "Mrs. Goldney became Organizing Secretary of the Society" but fail to mention that Dr. Dingwall himself was once its research officer.

The authors advance the theory that Harry Price, from lack of inventiveness, placed his imaginary séance with Rosalie in Brockley where years before he had attended some fake séances. They say they have discovered "correspondence which proved positively that Price has revealed that the séance was at Brockley", but though they quote extensively from all sorts of correspondence they give absolutely no details about this discovery. One suspects this lapse must have lost them several points of 'investigationmanship'.

D. J. WEST

RESEARCH ON FOOD

Advances in Food Research

Vol. 8. Edited by E. M. Mrak and G. F. Stewart. Pp. xii+437. (New York: Academic Press, Inc.; London: Academic Books, Ltd., 1958.) 12 dollars.

Processed Plant Protein Foodstuffs

Edited by Aaron M. Altshul. Pp. xv+955. (New York: Academic Press, Inc.; London: Academic Books, Ltd., 1958.) 26 dollars.

The Microbiology of Fish and Meat Curing Brines
Proceedings of the Second International Symposium on Food Microbiology held at Cambridge (United Kingdom) in April, 1957. Edited by Dr. B. P. Eddy. Pp. vi+336. (London: H.M. Stationery Office, 1958. Published for D.S.I.R.) 45s. net.

Bibliography of Food

A Select International Bibliography of Nutrition, Food and Beverage Technology and Distribution, 1936-56. By E. Alan Baker and D. J. Foskett. Pp. xii+331. (London: Butterworths Scientific Publications; New York: Academic Press, Inc., 1958.) 63s.; 11 dollars.

Flavor Research and Food Acceptance

A Survey of the Scope of Flavor and Associated Research compiled from papers presented in a Series of Symposia given in 1956-1957. Pp. vi+391. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1958.) 10 dollars.

THE ever-increasing number of published papers on all aspects of science makes it more and more difficult for scientific workers to keep abreast of what is being discovered. The streets of London are to-day filled with complex machines designed to enable a man to move rapidly and comfortably from place to place, yet the net speed of movement is slower now than it was in the days of the hansom cab. In just the same way, the congestion of publications makes it as difficult to-day to be well learned in one's subject as it was in the earlier centuries of science.

There are several ways of dealing with the situation. To read all the published material is impossible; to digest the great fortnightly editions of *Chemical Abstracts* takes more time and determination than many of us can command; even to master the close-woven pages of the annual reviews is sometimes a heavy task. The editors of "Advances in Food Research" have chosen the more scholarly approach. They have selected six authors, three from the United States, two from England and one from Holland, and asked each to write a critical review. The result is an excellent book. G. W. Scott Blair discusses rheology in food research with all the mathematical erudition which we would expect for an article in such a volume, but also with philosophical urbanity which is equally to be welcomed. P. A. Raelofsen reviews the out-of-the-way corner of the fermentation industries concerned with the processing of cacao beans. A. C. Hulme deals with the biochemistry of dying organisms, namely, apples and pears. F. A. Lee and M. Milner contribute excellent articles, the first on the blanching of vegetables and the second on new methods to detect and eliminate insect-infested grain. The total impact of the book is to emphasize the axiom that the line between pure and applied science is a blurred one when good scientists write.

"Processed Plant Protein Foodstuffs" is also an excellent compilation. With great thoroughness and in 955 pages the international team of thirty-eight