The remaining fifteen papers covered various branches of applied geophysics, such as electrical, magnetic, geochemical and seismic investigations, case-histories, use of computing machines, etc. S. Werner (Sweden) presented the case-history of the Stora Sjöfjärden iron ore-body (Northern Sweden). The ore-body was recognized in 1918 by means of the Tiberg magnetometer; however, no development or mining was undertaken. Modern measurements commenced in 1960 utilizing gravimeters and ground as well as air-borne magnetometers. Extensive drillings have given rise to control of the computed tonnage, the size, the dimensions and the iron content of the ore-body. Examples of geochemical exploration were given by B. Bølviken (Norway): as a whole, the samples were taken in streams and brooks. A statistical investigation of aeromagnetic anomalies was demonstrated by M. Puranen (Finland), while J. D. Cornwell (Sweden) gave an interpretation of some aeromagnetic anomalies from northern Sweden. Variations of sheet- and fault-type anomalies were described in connexion with the Tjäre-kah fold and the fault complex associated with the Tjäre-kah gabbro. A magnetic anomaly of 4,000 γ was considered to be due to an unusual contact between the gabbro and granite. Two papers dealt with the seismic method of surveying. S. Johansson (Finland) gave an address on the application of the hammer seismograph model, FS-2, for engineering projects such as constructions of roads, dams, canals, bridges, etc. Several results were given. In the second paper, B. Hasselström (Sweden) presented a series of refraction seismic determinations in relation to the determination of overburden and to the localization of weathered rocks. Examples included the application of the method in drawing up plans for power stations, harbours, tunnels, etc.

A. Metzger (Finland) described a method for electrical coring and its application for soil determinations. A. Breen (Norway) discussed measurements of the quotient of electromagnetic field strength by means of symmetrically built measuring apparatus. The design of a portable electromagnetic instrument ('Slingram') was shown by K. Westerberg (Sweden). A similar system has been used for several years with promising results for prospecting by aeroplane and helicopter. The numerical calculation for this new instrument was given by D. Malmqvist (Sweden), who presented a series of graphs and tables. L. Granar (Sweden) gave an account of an improvement of the 'compensator' method developed by K. Sundberg some forty years ago, while H. Brækken (Norway) discussed the inductive-electric method and demonstrated some experimental evidence. The series on electrical methods was concluded by D. S. Parasnis (Sweden), who gave a review of the resistivity method and presented several examples of the application and the utility of this method over the past forty years.

H. P. Moxes (Norway) presented an approach to the calculation of aeromagnetic and groundmagnetic measurements by means of the electronic computer GIER. The effect in different elevations as well as the derivative

components of the anomalies were considered. A. Vogel (Sweden) spoke on the interpretation of magnetic and gravimetric anomalies by means of the least-squares method and by the utilization of electronic computers. The data originated from a deep-seated eruptive massive.

At the business meeting reports were given by the various committees. The planning committee introduced rules and statutes for a Nordic Association for Applied Geophysics, one of the aims being to promote and enlarge Nordic co-operation within the domain of applied geophysics and its adjacent fields: the business meeting accepted the proposal unanimously. The following officers were elected: *President*, S. Werner (Sweden); *Secretary/treasurer*, J. Espersen (Sweden); *Council Members*, H. Brækken (Norway), M. Puranen (Finland) and S. Saxov (Denmark); *Representatives*, G. Törnqvist (Sweden), A. Breen (Norway), A. Metzger (Finland) and M. Maag (Denmark).

It was decided that the committees for geophysical education, for technical mapping problems and for a Scandinavian gravity map should continue for one more period. Committees for scale-model experiments, and for the applicability and the suitability of electronic computers in applied geophysics, were constituted. An invitation was accepted for the fifth Nordic meeting for applied geophysics to be held in Sweden in approximately two years' time.

Following the meeting, the participants were invited to a luncheon-visit at the Norwegian Geological Survey. The managing director, K. Ingvaldsen, gave a review of the institution. The Norwegian Geological Survey was originally a geological survey with headquarters in Oslo; however, a few years ago the survey moved to new buildings in Trondheim; at the same time the geophysical survey and the geochemical laboratory were incorporated. At present, the Survey employs about 150 people. The visiting delegates had an opportunity of seeing the various divisions and of gaining a definite impression of the many activities of the Survey.

On January 9 an excursion was organized to Fosdalen Mine, some 150 km north of Trondheim, and about 50 members of the meeting participated. Chief-engineer C. W. Carstens welcomed the guests, and Ø. Logn, geophysical engineer, gave a detailed lecture with a series of slides, figures and graphs of the geophysical background of the Mine. He also gave details concerning the drillings and arranged for an exhibition of various instruments and apparatus. Afterwards, a dinner was held with the personnel at the Mine acting as hosts.

It can thus be concluded that the fourth Nordic Meeting for Mining and Engineering Geophysics was most successful, the attendance being 100 per cent higher than at the second meeting in December 1959 and 50 per cent higher than at the third meeting in November 1961. The establishment of the Association as well as the creation of the journal, *Geoeexploration*—the first two issues being published in 1963 and three issues being planned for 1964—are important contributions to co-operation in the fields of mining and engineering geophysics. SVEND SAXOV

EXPERIMENTAL PSYCHOLOGY

AS the opening number of the twentieth volume of the *British Medical Bulletin*, an 80-page issue has been published concentrating on experimental psychology*. This is introduced and edited by Prof. Summerfield and contains fifteen short, but informative, articles ranging from human learning, short-term memory, selective attention, and vigilance, to experimental investigations of sleep, ageing and drugs. Some subjects are omitted

which might have been of particular interest to medical readers; as Prof. Summerfield points out: "Little is said about work on emotion, personality and social behaviour, or on problems derived from psychiatry". In spite of these omissions, this is a very well-organized, very competent review of those areas dealt with. All are written by experts, many of whom describe work of their own, not always published, thus giving a sense of urgency and of being up to date to their contributions. The bibliographies are uniformly excellent and will take the

* *British Medical Bulletin*. *Experimental Psychology*, 20, No. 1; January 1964. (London: The British Council.) 30s.

reader straight to the forefront of research in the field considered.

One point which may puzzle the reader a little relates to the question of just whom the work is intended for. Medical people unacquainted with experimental psychology will find the going very hard; because of the limited space available to each contributor the argument, the theoretical analysis and the description of experiments are necessarily very much abbreviated and not readily understandable to anyone but an expert. Experts, on the other hand, would not normally turn to a publication of this kind for information in their own subject; there are well-known sources for publication of reviews of limited areas. Perhaps the most likely readers will be students of psychology immediately before or after their degree examinations; for them an authoritative summary of this type, up to date and well written, will be a godsend. Unfortunately they might find the price rather off-putting; 30s. for 80 pages works out at about 1s. for 3 pages, which is rather expensive for a paper-bound issue.

A perusal of the contributions makes very apparent the truth of certain generalizations often made about experimental psychology. Thus it is clear that an enormous amount of very ingenious and well-controlled work is going on in psychological laboratories; no quarrel is possible with the technical competence of the work reviewed. However, what is missing are the general laws and high-level theories which bind together a field, or even a small part of a field. This is often excused on the grounds of the great youth of psychology; the passing years, however, do not seem to bring us any further into the Promised Land! Perhaps we are not always looking in the right direction or perhaps the rather self-conscious anti-theoretical bias of many psychologists prevents them from discovering these generalizations which alone can make the subject a unified science. The reader might be excused for wondering whether, in fact, all these contribu-

tions belong to one single science, as there seems to be very little congruence between them; as in the typical psychological text-book the chapters are independent of each other, there is no logical structure, and they might be rearranged quite arbitrarily without affecting one's ability to apprehend the various contributions.

This feature of the present issue of the *British Medical Bulletin*, and of experimental psychology as a whole, is perhaps not unrelated to the exclusion of personality. Psychology has tended to concentrate on functional relationships between stimulus and response; in this way it was hoped that the paradigm of the physical sciences could be taken over. However, simple *S-R* types of analysis have proved abortive; the same stimulus may produce different responses in different people, or even in the same person at different times. It has become imperative to introduce the organism in the formula, and much lip-service is paid to this by writing functional relationships in terms of *S-O-R*. However, individual differences, which are the characteristic properties of the organism, still tend to be regarded in the same way as experimental errors, that is, as a nuisance to be eliminated by averaging. This is as sensible as a physicist trying to eliminate the differences between the elements, say with respect to conductivity or melting point, by simply running averages over large and random aggregates of materials. It is only when it is realized that individual differences are not only a legitimate subject-matter for scientific research but also form an essential part of all experimental psychology that a greater degree of organization will become apparent in the contributions of experimental psychologists. However, this is a fault of the subject, not the editor or the writers, and it would be churlish to end on a critical note instead of recommending wholeheartedly what is undoubtedly one of the best issues of the *British Medical Bulletin* for a long time.

H. J. EYSENCK

LIMITATIONS OF THE RESEARCH PAPER

THE research paper, which appears throughout the world each year in its hundreds of thousands, has been cast in a traditional form for decades. It was not ever thus. The early *Proceedings of the Royal Society* and others of less eminence were not only lively but showed a high degree of subjectivity, thereby leaving us valuable clues to the nature of the men who formed these and other specific bodies and the workings of their minds. Scientists have become more reticent and humble and sometimes deceive themselves into thinking that they are producing completely objective accounts of their work, which have been described as "didactic dead-pan". There is much excuse for this. Scientists would like to feel that they produce results which others can verify and experiments which others can reproduce. Moreover, editors of scientific journals would encourage a succinct form of reporting and would prefer tabulated results to an account of the mental processes of the research worker, even if he were able to catch his mind at work and analyse step by step the formation of his ideas.

A series of Third Programme talks given in the autumn of 1963 under the title of "Experiment", published in *The Listener* and now available in the form of a B.B.C. paper-back*, consists of a number of variations on Prof. P. B. Medawar's opening talk, "Is the Scientific Paper a Fraud?". He was not challenging the techniques and skills of the research worker or the veracity and even value of his facts, but was making a plea for a recon-

sideration of what is understood as scientific method. Francis Bacon, in presenting induction as the method of science, saw that the process of deduction only uncovers and makes explicit information that is already present in the axioms or premises from which the process of deduction started.

"The process of deduction reveals nothing to us except what the infirmity of our own minds has so far concealed from us." In the nineteenth century, John Stuart Mill formulated more precisely the principles of induction which he believed to be the method of science. Briefly, observations, unprejudiced and even naïve, were to be made in sufficient quantity and, out of all this sensory evidence, generalizations will grow and take shape "almost as if some process of crystallization or condensation were taking place". J. S. Mill wished to apply to sociology the methods which seemed to have proved so useful in the physical sciences, but the application of induction to sociology proved to be singularly unfruitful. The theory sustaining the inductive method can be challenged on several grounds. To start with, there is no such thing as unbiased observation, for all observation is a function of past experience. Again, the formulation of a scientific idea and the demonstration or proof, though confused by Mill, are two separate activities. In deduction they may well be the same, but in scientific activity they are different; but, most important, a generalization cannot contain more information than the sum of the particular statements on which it is founded. Thus, it is not surprising that Bertrand Russell in 1903 said that "induction was a mere method of making plausible

* British Broadcasting Corporation. *Experiment: a Series of Scientific Case Histories first broadcast in the BBC Third Programme*. Edited by David Edge. Pp. 72. (London: British Broadcasting Corporation, 1964.) 4s.