impurity nuclei showed evidence for disturbing effects which occurred while the ion was coming to rest. Several papers reported particularly accurate values of hyperfine fields which were obtained from the nuclear resonance disturbance of nuclear orientation and angular correlation experiments: this technique although still in its infancy seemed promising. Among the more powerful methods for investigating the static properties of nuclei is that of the hyperfine structure of the X-rays which follow the capture of mu-mesons by atoms. This structure is particularly sensitive to the distribution of electric quadrupole moment in the nucleus. The availability of mu-mesons beams combined with the use of high resolution germanium counters has opened up this important field.

For those who attended the conference this volume is an excellent record of what must have been a valuable and delightful meeting set in the sunshine of California: the editors are to be congratulated on the quality of its preparation. For those familiar with the field and wishing to get up to date and for those wanting to acquaint themselves with these important developments, it is a collection containing many useful and stimulating papers: reading them in this form is certainly easier than searching through learned journals. Nevertheless, this book, which is both large and expensive, has neither the coherence and completeness of a monograph nor the permanent worth of a series of definitive papers and it may not appeal to the discriminating purchaser. M. A. GRACE

RADIO COMMUNICATIONS

Ionospheric Radio Communications

Edited by Kristen Folkestad. (Proceedings of a NATO Institute on Ionospheric Radio Communications in the Arctic, organized by the Canadian Defence Research Telecommunications Establishment and the Norwegian Defence Research Establishment, at Finse, Norway, April 13–19, 1967.) Pp. xi+468. (Plenum: New York, 1968.) $25.00.

ROUTINE radio sounding of the ionosphere started nearly forty years ago and, although over the years there have been some significant advances in the application of ionospheric data to certain radio communication problems (as, for example, in the forecasting of long-term trends in ionospheric conditions), many practical problems still remain unsolved. This is particularly true of radio communication in high latitudes where the ionosphere is frequently subject to a variety of minor and major unpredictable disturbances. The extreme variability of the polar ionosphere was clearly recognized as early as 1932 at the time of the Second International Polar Year, when the occurrence of the so-called "polar radio blackout" was first identified. Considerable progress has recently been made in understanding many of the basic causes of polar ionospheric disturbances, but much less has been done to combat the consequent problems of radio communication in the Arctic and Antarctic. The satisfactory solution of all long distance radiowave propagation problems calls for the cooperation of the ionospheric physicist, the communication engineer and the practical operator, and in April 1967 a joint meeting of experts in these three fields was organized at Oslo under the auspices of the North Atlantic Treaty Organization. Particular attention was directed to radio communication problems in Arctic regions.

The present volume summarizes the proceedings of that meeting and consists of some thirty papers grouped under the following main sections: morphology of the Arctic ionosphere and ionospheric absorption, LF and VLF communication, scatter communication, HF communication, system techniques, existing communication facilities and user problems in the Arctic. Each section includes a short summary of the discussions which took place at the conference and a final section is devoted to a survey of future developments in this field. It is clear that the conference, itself concerned with radio communication problems, certainly succeeded in focusing attention on a communication problem of another sort, viz., a certain lack of communication between the various interested parties referred to above. Indeed, the concluding chapter of the volume is entitled "Bridging the Gap between Physicist, Engineer and User".

Although much of the material is necessarily of a general review character and many of the scientific results quoted have appeared in papers published elsewhere, nevertheless, for those specifically concerned with the problems of radio communication in polar regions, the volume should prove a valuable and convenient reference book. The volume is well produced and provided with an adequate author and subject index. W. J. G. BEYNON

OBITUARIES

Dr D. W. W. Henderson

DAVID WILLIS WILSON HENDERSON was born in Glasgow on July 23, 1903, the only child of the late John and Mary Henderson. A boyhood interest in science and agriculture led him to choose agricultural bacteriology as his major subject when he entered the University of Glasgow and he graduated there in 1926. He moved to a teaching post at King's College, University of Durham, where he started research on the diseases of sheep, submitting the results as a thesis for his MSc, which he obtained in 1930. In the same year, he married his first wife, Beatrice Mary Davenport, daughter of Sir Westcott Abell.

In 1931 Henderson obtained a two year Carnegie Research Fellowship with which he went to the Lister Institute of Preventive Medicine and followed this with a Beit Memorial Fellowship from 1932 to 1935. Here Henderson's interest turned to human pathogens, particularly anaerobes, and he began to publish papers both under his sole name and with his colleagues. He submitted a thesis, "Studies on the Spore Bearing Anaerobes with Experiments on Active and Passive Immunity", to the University of London for his PhD, which he received in 1934. He was awarded his DSc in 1940 for his published work.

Soon after the outbreak of the Second World War, Henderson's experience of the toxins of the *Clostridia* led him to try to deliver a toxic dose to mice by the respiratory route. The experiment was so successful that his director, Sir John Ledingham, arranged for him to spend part of his working time at the Chemical Defence Experimental Station, Porton, where considerable experience in the handling of toxic aerosols already existed. In 1940, when an MRC Unit was moved to Porton to assess the risk of the use of biological agents against man, Henderson joined it, though he remained a member of the staff of the Lister Institute until 1946. After the United States entered the war, Henderson was sent to assist them to establish an experimental unit and thereafter spent a good deal of time in the USA, where he successfully collaborated with a number of American microbiologists and made many lasting friendships. In recognition of his contribution he was awarded the Medal of Freedom, bronze palm.

By the end of hostilities, it was clear that biological attack was feasible, but Henderson considered that the *ad hoc* approaches used during the war were unlikely to yield any estimate of the magnitude of the threat. A long term programme of basic research was required and Henderson offered to direct it. After some argument over

objectives and priorities, he was appointed director of the Microbiological Research Department in January 1946. His first tasks were to recruit staff and to plan new laboratories. Neither was easy, but Henderson threw himself into both with determination, recruiting staff one by one on the basis of their individual research potential rather than their scientific discipline or the specific requirements of the research programme. In June 1951 he and his staff moved into the new laboratory, specifically designed for the safe production and study of micro-organisms, including pathogens, on a large laboratory scale. Shortly afterwards, he recommenced publishing papers, sometimes alone, as when the "Henderson apparatus" for exposing animals to aerosols was described in detail (*J. Hygiene*, **50**, 53; 1952), and also with colleagues. By 1954, he was able to report good progress in person to the Royal Society (*Proc. Roy. Soc.*, B, **143**, 192; 1955). In the following year he had sufficient confidence in his staff and in the self generating momentum of the research programme to take a year's sabbatical leave. Since no other laboratory could offer better facilities for studies on respiratory infection, he spent it at the bench in his own laboratory. The results were published in a short series of papers in 1956.

Henderson continued to expand the scope and extent of research, and his efforts to establish a "centre for microbiological research" with emphasis on the prevention or curtailment of the infectious process rather than on therapy and treatment were acknowledged by his admission as a Commander of the Most Excellent Order of the Bath (1957). By 1959, the establishment had acquired a national reputation and in some spheres an international one, and Henderson's personal contribution was recognized by his election as a Fellow of the Royal Society. Henderson spent the next few years trying to balance up his research team and to open up leads to civil application from the defence research done in the establishment, but the strain of his many battles was beginning to tell. Hypertension was mounting steadily and he was increasingly subject to attacks of acute respiratory infection during the winter. By 60, he, who had never understood why men retire early, was eagerly seeking a successor, and no one was more pleased than he when Dr C. E. G. Smith was appointed in August 1964. By the end of the year he had completed the handover, and withdrawing wholly and tactfully from "management" and "policy" he went back to the laboratory. At about the same time he completed his two years' term as President of the Society of General Microbiology.

Back at the bench, Henderson sought to apply to viral aerosols the same quantitative methods that he had used fifteen years earlier with bacteria. He became increasingly interested in the sequence of pathological events and showed the rapidity with which a respiratory infection with Semliki Forest virus reached the brain of the hamster (*Brit. J. Exp. Pathol.*, **68**, 228; 1967). He made good recoveries from several minor thromboses, but another in July 1967 brought his active work to an end. He was in and out of hospital several times in the ensuing year, but his condition slowly deteriorated and he died in his sleep on August 16 this year.

Professor V. B. Stockmann

PROFESSOR VLADIMIR BORISOVICH STOCKMANN, who was born in Moscow on March 10, 1909, devoted his whole career to physical oceanography. He began in the State Oceanographic Institute in 1931 as a laboratory assistant, but was quickly promoted to the senior research position. In 1934 he organized the Laboratory of Physical Oceanography in Bakou on the Caspian Sea. In 1938 the Faculty of Physics of the University of Leningrad awarded him the first scientific degree (candidate of sciences) *honoris causa*. Since 1939 he has worked in the Institute of Theoretical Geophysics and in the Arctic Research Institute. When, in 1943, the USSR Academy of Sciences established the Laboratory of Oceanology, he moved there and worked in this laboratory (later reorganized into the Institute of Oceanology) until his sudden death on June 14 this year. He received his DSc degree in 1943.

Stockmann's most important contribution was to the theory of ocean currents. In the early forties he drew attention to the importance of the wind stress vorticity in determining circulation patterns in the ocean. Applying this principle to the major features of the ocean circulation, he succeeded in developing the theory of the well known equatorial countercurrents in the oceans.

In 1946 he developed a new method for studying general ocean circulation—the method of total flows—used later by many other scientists. On numerous examples he demonstrated the effectiveness of the practical application of this method and proposed various ways of overcoming some of its natural restrictions (analogy with elastic membranes, density model, and so on).

Very early in his scientific career he became interested in oceanic turbulence and mixing processes. He paid particular attention to developing indirect methods for evaluation of eddy viscosity and eddy diffusivity in the ocean and to the theory of T,S-diagrams. During his last years he gave much of his energy to the planning and implementation of multi-ship and multi-buoy operations for the continuous study of oceanic turbulence and its spectral characteristics.

In the Institute of Oceanology, Stockmann built up a strong research team of young and enthusiastic scientists interested in the theoretical aspects of modern oceanology. In 1946 this group was administratively organized as the Laboratory of Marine Hydrodynamics (later Department of Theoretical Studies) and Stockmann remained its head until he died.

ERRATUM. In the communication "Molecular Pathology of Human Haemoglobin" by M. F. Perutz and H. Lehmann (*Nature*, **219**, 902; 1968) the third sentence of the seventh paragraph on page 903 should read "This means that in a 0·65 per cent solution of haemoglobin Kansas half the molecules would be dissociated into dimers, compared with about one-twenty-sixth in a similar solution of haemoglobin A." The word "molecules" at the end of the fifth line of the second paragraph should read "globin chains". The footnote marked by an asterisk in Table 1 should read personal communication from J. Greer; that marked by a dagger should read Opfell, R. W., Lorkin, P. A., and Lehmann, H., *J. Med. Genet.*, **6**, 257 (1968) (in the press). The asterisk by Santa Ana in column 2 of the table should, in fact, be a dagger. Reference 57 should read *Biochim. Biophys. Acta*, **140**, 231; 1967).

ERRATUM. In the article "Molecular Biology Comes of Age" (*Nature*, **219**, 825; 1968) reference 13 on page 829 should refer to R. R. Traut, and not P. R. Traub.

CORRESPONDENCE

Naming the Units

SIR,—Re the letter "Naming the Units" in the issue of August 17 (*Nature*, **219**, 765; 1968), and in case no one else has pointed this out, in French a unit of 10^9 is *un milliard*, and one of 10^{18} is *un trillion*.

Yours, etc.,

A. LODGE

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Swanley, Kent.