Sir David Brunt opened the discussion by saying that he had encouraged the organization of this meeting as he was anxious to know how the environment which he had studied as a meteorologist affects the bodies which the physiologists set out to study. His idea had been to stimulate interest in the climatic conditions under which man ceases to work efficiently and to discover whether physiologists and psychologists are prepared to find out more about this. The lively discussion which followed centred largely upon the word 'comfort'. Miss M. V. Griffiths and others spoke about the advantages of floor heating. It was stated that if the temperature of the floor is 72–75° F. people in the room can be maintained in comfort when the temperature of the room itself is only 54° F., though this was doubted by Dr. Bedford—evidently one of the world's 'cold mortals'. The heating and ventilation of motor buses also came in for some discussion, a matter of some importance to many people to-day. The most satisfactory system seems to apply the heat near the floor and ventilate the bus near the ceiling. Reducing the humidity brought in on wet clothes and inseparable from expired air appears to be a very important matter in bus management because, apart from the comfort of the travellers, it greatly reduces the time which has to be spent by the maintenance staff in sponging down the interiors to keep them clean. Two geographers joined in the discussion and pointed out the importance of work of the kind described at the meeting for anyone who has to study man's place in Nature. Both put in a plea for more work of the same kind and also for meteorological records which could be made the basis of geographical science. At present the material supplied to them by the meteorological services gives no clue as to how a man would react under those conditions. In a final word, Prof. Glaser pointed out that any discussion of comfort must take into account the fact that what is comfortable for *A* is not comfortable for *B*, and that what is uncomfortable for *A* to-day may be quite comfortable for him in a few weeks time when he has become acclimatized. He also pointed out something much more striking, namely, that comfort can be achieved at an internal temperature relatively far removed from the person's 'normal' one; and as a last shot at the reliability of comfort as an index of any value, he directed attention to the fact that the man in a *rigor* from malaria with a rising temperature usually feels most miserably cold.

OBITUARIES

Prof. A. Sommerfeld, For.Mem.R.S.

The death of Prof. Arnold Sommerfeld, at the age of eighty-three, occurred in Munich on April 26, after he had been knocked down by a motor-car.

With Sommerfeld one of the physicists has passed away who helped transform physics from what we now call classical physics to the new or quantum physics. "Quantum Theory is a child of the twentieth century", Sommerfeld was fond of saying, alluding to the fact that Planck introduced the quantum constant h in the theory of black-body radiation in 1900. Much of the rearing of this infant fell to Sommerfeld.

Sommerfeld's main contribution to quantum physics consists not of the fundamental laws or models. To his name there remains attached the fine structure constant and the method of applying quantization to more than one variable; the discovery of selection and intensity rules and thereby the interpretation and classification of a wealth of spectroscopic data in the optical and X-ray region; and the opening up of a new era in the theory of metals by his application of Fermi statistics to the electrons in metals. His main importance lies in his untiring probing into the new methods of atomic physics, by carrying problems to the ultimate test of quantitative agreement between experiment and theory. He was tireless in propounding the new theory at home and abroad in a spirit of optimism and enthusiasm; and no one has done so much for the consolidation of the rapidly developing new physics as he did by the five editions of "Atombau und Spektrallinien" which appeared between 1919 and 1931, each with many chapters re-written and brought up to date. Physicists all over the world have derived great profit from this labour, which seemed scarcely to interrupt the steady flow of research papers of Sommerfeld himself and his numerous pupils.

Sommerfeld was proud that he came from Königsberg, a geographical outpost and spiritual bastion among German universities. His father was a medical man, and the son graduated at the Gymnasium (1886) and University (1891) there. Franz Neumann, then ninety years old, who was the originator of the teaching of theoretical physics as a subject in its own rights and of the seminar method of teaching theoretical subjects, had made Königsberg one of the foremost schools for mathematics and mathematical physics. Sommerfeld's dissertation (under F. Lindemann), on "The Arbitrary Functions in Mathematical Physics", deals with the development of functions according to systems of orthogonal functions. Up to his death Sommerfeld found occasion to enlarge on this first brilliant work of his.

The full power and originality of Sommerfeld's mathematical construction appeared soon after in a series of papers on the diffraction of light by an edge (1894). The advance of this theory over previous ones (Fresnel, Kirchhoff) lies in defining the solution entirely by the differential equation of wave propagation together with the boundary conditions on the opaque half-plane; the method is an ingenious combination of image methods and of Riemannian multiply connected planes. In later years (1911), Sommerfeld extended the method when he discussed the diffraction of X-rays by deep wedge-shaped slits (Walter and Pohl) in papers that led to a reliable value of the then still unknown wave-length of X-rays.

In 1895 Sommerfeld became assistant to Liebisch in the Mineralogical Institute in Göttingen; but soon after he turned to more inspiring work than drawing crystals by becoming assistant to Felix Klein. This great master of mathematical synthesis deeply impressed Sommerfeld. Together they planned and carried out the writing of the four monumental volumes "Theorie des Kreisels" (1897–1910), in which the subject of gyroscopic motion is used as a theme for making evident the manifold connexions between dynamics and a variety of mathematical subjects.

The period in Göttingen ended in 1897, when Sommerfeld was appointed to his first chair, that of mathematics at the Bergakademie in Clausthal in the Harz Mountains, not far from Göttingen. The three years he spent there, newly married, were very happy ones.

His next appointment was the chair of applied mechanics at the Technische Hochschule, Aachen (1900–6). His contact with the engineering school turned his interest to applied subjects, even although he tackled problems of fundamental importance. The papers of this period, on viscous flow lubrication, on friction, on the beats between generators working on the same grid, are among those to which Sommerfeld liked to look back in a spirit of satisfaction not unlike that of Goethe's Faust when he speaks of the improvements he is bringing to the country by constructing canals and irrigation.

At the same time, the problems of ether physics were occupying Sommerfeld. The proper modes of vibration of a rigid spherical electron was a problem seriously discussed at that time, and Sommerfeld, like others, wrote highly mathematical papers on this subject, of which the last appeared in 1905, the year of the birth of relativity. Of more lasting importance are his studies of the electromagnetic fields which are emitted by the sudden stopping of a cathode ray, the *Bremsstrahlung* or white X-ray radiation according to the hypothesis formulated independently by Stokes, Liénard and Wiechert. This subject was followed up as, through the experiments of Barkla on the polarization of X-rays, more than mere total intensity data became available, and as similar effects were measured for gamma-rays. Later it appeared repeatedly in quantum form in papers by Sommerfeld's pupils.

Meanwhile, Sommerfeld had moved to Munich. It was Röntgen, the mighty man in the philosophical faculty, who insisted that Sommerfeld would be a worthy successor to Boltzmann in this chair that had been vacant for some time. A small but autonomous Institute for Theoretical Physics was connected with the chair. The workshop facilities and a few instruments made it possible to illustrate by simple experiments some of the conclusions arrived at in the theoretical courses. L. Hopf's work on Reynolds's number for flow in an experimental river-bed, and soon Laue, Friedrich and Knipping's discovery of X-ray diffraction by crystals, fully justified the existence of such an institute which had appeared to some as a self-contradiction.

In Munich Sommerfeld soon began to attract students in ever-growing numbers. P. Debye, whom he had brought with him from Aachen as his assistant, shared with Sommerfeld the success of building up a first group of graduate students who were keenly intent on physics and also enjoyed the colourful life which Munich offered by the combination of its natural and artistic climate. Many a problem was raised and discussed in the after-lunch meetings in the Hofgarten Café, between Sommerfeld and his group, the experimentalists from Röntgen's laboratory and those of the Technische Hochschule. These frequent informal meetings of physicists of various degrees of experience were most stimulating, even more so than the official colloquium which took place once a week during term-time.

Sommerfeld's success as a teacher was due to the clear and concrete expression of his ideas, and to the choice of subject in his lectures, which made even the young student realize that behind the domain of established theory there follows a domain of unsolved problems. The research on which he was currently engaged often occurred in preliminary form in Sommerfeld's course lectures ; thus in 1909 the theory of relativity appeared in his electrodynamics course at a time when he was developing the four-dimensional vector form of this theory, and in 1927 the application of Fermi statistics to metals. This made his introduction to physical theory always an exciting experience full of reality. Further, Sommerfeld had a keen appreciation of intellectual capacity and real endeavour at whatever stage it appeared, and he was a friend, not only a teacher, to his students. He took them home and made them perform, or listen to, music or reading. In winter, skiing expeditions would be organized during week-ends or in the Easter vacations. On such occasions a long line of physicists might be seen making their way up the snowy slopes, and a panting discussion might be heard through the clean cold air of recent or future experiments and theories.

Among the problems of applied physics to which Sommerfeld and his pupils made essential contributions, that of the propagation of electric waves along the surface between two media stands foremost. His student days had been marked by the impact of Hertz's experiments on the theory of electromagnetism. In 1898 he gave a quantitative theory of Hertz's results on waves along wires ; in 1911 his pupil Hondros discussed waves of all types travelling along dielectric rods. Starting in 1909, a series of papers dealt with the propagation of radio waves along an earth assumed flat or spherical, and with the directed action of horizontal antennæ (v. Hoerschelmann). Many years later, Sommerfeld gave a condensed account of this group of papers in Franck and Mises' book on partial differential equations in physics.

Regarding Sommerfeld's contributions to the development of atomic theory, the account can be short, because this is so much more recent work that it is still firmly imbedded in the memory of university teachers in many countries, who are handing on to the new generation their own personal impressions of Sommerfeld and his work, which they gained either at his school or in the course of his extended visits to other universities (Spain, 1922 ; United States, 1922–3 ; England, 1926 ; India, Japan, California, 1928–29 ; Volga congress, 1930 ; Ann Arbor, 1931). Sommerfeld's book "Atombau und Spektrallinien" has been, from 1919 on, an unfailing guide through the rapidly accumulating volume of atomic theory. In 1929 it was supplemented by the "Wellenmechanischer Ergänzungsband", which, some years later, was converted into a full-fledged companion volume "Wellenmechanik" (3rd edit., 1944). With the advent of wave-mechanics, theoretical atomic physics returned to the type of eigenvalue problems which had been Sommerfeld's favourite field from his early days on. No wonder that he impressed his personal stamp on the account of the new subject.

Among the major decisions in Sommerfeld's life were the refusals to accept the chairs of theoretical physics in Vienna (1917) and in Berlin (1927). He retired from the Munich chair in 1935, but continued intensive scientific activity up to the very last. The six volumes of "Vorlesungen über theoretische Physik" (the last of which is being prepared for publication) are, as he wrote, a bequest to the young generation ; their preparation enabled him to survive the political chaos during his years of retirement. It is hard to believe that so vigorous and in many ways novel an account of classical physics should have been written by a man nearing, or even surpassing, his eightieth year. Two of the volumes have appeared in English translation, and the others are to follow shortly.

With his long list of scientific papers and his monumental books on atomic theory and on classical physics, Sommerfeld will always be regarded as an imposing figure standing on the threshold between two periods in the history of physics. As long as his pupils live, they will bear an affectionate memory of a great teacher and unselfish friend.

P. P. Ewald

Mr. Lincoln Ellsworth

Lincoln Ellsworth, whose death took place at the end of May, was one of the pioneers of polar flying, both in the Arctic and the Antarctic. He was born in Chicago in 1880 and was employed for several years on survey work on Canadian railways, and also as an assistant engineer on goldfields in Alaska. During the First World War he was in the U.S. Army Air Corps.

Ellsworth first became known to a wider public in 1925, when his father decided to finance a flight which Roald Amundsen was planning to make to the north pole in Dornier-Wal flying boats. When near the pole it was found necessary to land on a lead of open water in the polar pack. The take-off, however, proved extremely difficult. One of the flying boats was abandoned, and it was three weeks before the other was again airborne and able to return to Spitsbergen from a farthest north latitude of 78° 44′.

Next year Ellsworth again collaborated with Amundsen, who was negotiating for the purchase of an Italian airship, renamed the *Norge*. Nobile was the technical expert, Amundsen provided the polar knowledge, and much of the financing again came from Ellsworth. The expedition was entirely successful. It took off from Kings Bay, Spitsbergen, on June 11, 1926, and after crossing the north pole landed at Teller in Alaska three days later.

Ellsworth's next effort was to assist Sir Hubert Wilkins in plans for a voyage in 1931 from Spitsbergen northwards under the pack-ice in the submarine *Nautilus*. He did not himself take part in the expedition, but was one of the party that same summer on the airship *Graf Zeppelin* on her Arctic voyage from Friedrichshafen over Franz Josef Land and Severnaya Zemlya (Nicholas II Land).

This first contact with Wilkins was the beginning of a long and intimate association, and Ellsworth now turned his attention to the Antarctic, with Wilkins as his adjutant. His first attempts, however, in 1933–34 at the Bay of Whales in the Ross Sea, and in 1934–35 from Snow Hill on the east coast of Graham Land, were unsuccessful; but next year, with Hollick-Kenyon as pilot in a Northrup machine, the *Polar Star*, a flight was made from Dundee Island on the north-east coast of Graham Land across Antarctica to the Ross Sea. No less than three landings were made, and the flight, which had begun on November 23, 1935, ended on December 4, when the machine landed on the Ross Barrier some miles inland from the Bay of Whales. Ellsworth's radio had failed at an early stage in the flight, and in view of the uncertainty arising the British, Australian and New Zealand Governments in collaboration decided to divert *Discovery II* from her usual oceanographical work. She arrived at the Bay of Whales on January 15 and rescued Ellsworth and his companion, who had been living in an ice cave for six weeks. This flight was the most successful yet made in the Antarctic, and the three landings to wait until the weather improved were a completely new departure in polar flying, representing a striking advance from Ellsworth's flying boat experience in 1925.

After his trans-continental flight, Ellsworth made one more expedition to the south, in 1938–39, when a flight was made over Princess Elizabeth Land at 12,000 ft. along the 79th meridian to 72° S. On his return, Ellsworth sold his ship *Wyatt Earp* to the Australian Government, having by now seen polar flying develop from the first uncertain stages to his own successful flight across the Antarctic continent.

J. M. Wordie

Miss V. E. Benes

Vlasta Eva Benešova was born in Kutna Hora, Bohemia, on December 2, 1919. She studied at the Lycée at Kolin and was a distinguished student in the Pharmaceutical Department of the University of Prague. After holding various provincial appointments she returned to Prague and began to carry out research work on "La sedimentation des Algues", under Prof. Silvestr Prat. In 1947, with the aid of a bursary, she proceeded to Paris and continued her research at the Sorbonne under Prof. W. Plantefol. She published three papers in the *Comptes rendus* of the Paris Academy of Sciences in 1948 and 1949, her work on *Hæmatococcus pluvialis* being an important contribution to our knowledge of the Volvocales. Afterwards, fired with enthusiasm by a visit to the marine station at Roscoff, she began a serious study of the marine algæ, under Prof. J. Feldmann and M. Chadefoud. In 1949 she sailed for Australia, where she collected marine algæ extensively on the coasts of New South Wales and made an intensive search for members of the Ceramiales with the view of a detailed study of their life-cycles. Despite her language difficulty she taught easily, and Prof. Burges writes of the active and successful contribution that she made to the study of the algæ in the University of Sydney. Towards the close of 1950, in a serious fall in the laboratory, she fractured her pelvis; but she made a good recovery and returned again to collect on the shores of New South Wales, a locality for which she had developed a deep regard. Perhaps it was too soon for her to venture alone on reefs as difficult as those near the Woy Woy Research Station, for to the dismay of her friends, on March 10 she did not return from the collecting ground.

Prof. Feldmann writes: "Sa tragique disparition qui est venue si soudainement interrompre sa carrière, constitue une perte sensible pour l'Algologie. Mais le souvenir de Vlasta demeurera surtout vivace dans le cœur de ceux qui l'ont connu et ont pu apprecier ses qualités d'esprit et de cœur."

Lily Newton

We regret to announce the following deaths:

Prof. J. W. Bigger, during 1924–50 professor of bacteriology and preventive medicine in the University of Dublin, aged fifty-nine.

Harald Blegvad, secretary-general of the International Council for the Exploration of the Sea, on August 22, aged sixty-five.

Brigadier E. M. Jack, C.B., C.M.G., director-general during 1922–30 of the Ordnance Survey, on August 10, aged seventy-eight.

Dr. John R. Loofbourow, associate professor in the Massachusetts Institute of Technology, known for his work on absorption spectroscopy and the biological effects of radiation, on January 23, aged forty-seven.