equations of gravitation are sufficient to determine the orbits of planets, or whether separate equations of motions are necessary. Fock's answer is that no such assumptions need to be made; he obtains Newton's laws as a first approximation for small bodies separated by large distances and develops the relativistic correction terms. I had a short discussion with Fock on Mises' foundation of the theory of probability and found him very sceptical: to define probability as the limit of relative frequencies in an actual series of trials seems to be a vicious circle, for there is no certainty of the existence of such a limit, but only a probability. I think Fock is right. He is also a great expert in quantum mechanics. I found him and the other Russian physicists perfectly acquainted with the newest developments, in particular of the theory of quantized fields and its application to radiation and mesons. J. Tamm (Moscow) and J. Frenkel (Leningrad) are working on these problems; their attitude to the well-known difficulties and perplexities is not much different from my own. To mention only one point, they are not satisfied by Eddington's ingenious theory of ultimate particles. Among the many other questions we discussed, I wish to direct attention to Frenkel's dynamic theory of atmospheric electricity, which has just appeared and seems to me very promising. As Andrade has already pointed out, Frenkel is attached to Joffe's laboratory in Leningrad and takes an active part in the interpretation of the experiments on semi-conductors and other things.

In an account of theoretical physics, the theoretical part of physico-chemistry cannot be excluded. In Moscow it is brilliantly represented by Frumkin, in whose laboratory well-planned work is done on the chemistry and physics of surface layers.

Russian physics suffered a great loss last year by the death of Mandelstam who, together with Landsberg, discovered almost simultaneously with Raman and independently the phenomenon since called the Raman effect. Mandelstam's optical school is continued under Landsberg's leadership. Another member of it is E. Gross, who discovered the splitting of spectral lines in a beam of light which is scattered by a liquid or a crystal, an effect due to the Doppler effect produced by the reflexion of the light waves on sound waves.

Russian physicists were very keen to learn something about work done in Britain, and I had to give several lectures. One of these was in the Lebedev Institute of Physics, the director of which, S. Vavilov, has just been elected president of the Academy of Sciences of the U.S.S.R. This visit gave me the opportunity of a glimpse of the celebrated laboratory and a discussion with its workers on diverse problems.

The limits of this article do not allow me to give an account of new discoveries in crystal physics and their explanation. I must, however, add a few remarks to Andrade's description of Kapitza's Institute for Physical Problems and the work done there. For this Institute contains a separate group of theoretical physicists under Landau's leadership who have made essential contributions to the low-temperature work going on. Kapitza himself is an expert in thermo-dynamics, which he applies as an engineer to the technical problems of the liquefaction of air, and as a physicist to research on liquid helium. It is most remarkable and characteristic of Russian science how applied and pure physics, experiment and theory, are here combined. Andrade has mentioned Landau's theory of superfluidity which was published in 1941, but has been improved by him and his collaborators. It will cause the theorists some 'headaches'; for though it is most successful in predicting experimental results, for example, the existence of two different velocities of sound (the normal one of about 220 m./sec. and a slow one of about 20 m./sec.), it also contains many obscurities. The first part deals with the quantization of the hydrodynamical equations for ideal liquids. The second part describes helium II as a mixture of two phases, or interpenetrating liquids, one having viscosity, the other not. This new and surprising idea is clear in itself but scarcely connected with the first part. The link is a consideration about the quantization of vortex motion, which leads to the conclusion that the range of energy states (of the whole liquid) consists of two parts separated by a gap $\triangle$, one part representing the irrotational, the other the vortex motion. The existence of this finite energy $\triangle$ prohibits, for slow motions of the liquid, the excitation of quanta, therefore the transfer of momentum from the walls, and this means lack of viscosity. Landau gives an expression for $\triangle$ in terms of density ρ, mass of the atom m and Quantum constant $\hbar$; the formula as published is wrong, but the idea is right. One has simply to remember the well-known expression for the so-called degeneration parameter from the Einstein-Bose or Fermi-Dirac statistics, $A = n\hbar^3/(m\triangle)^{3/2}$ where $n = \rho/m$ is the number of particles per unit volume. If $\triangle$ is expressed in terms of a critical temperature T_c, $\triangle = kT_c$, then for $T_c = 1°$ K. the dimensionless quantity A is very small for a gas, but of the order unity for a liquid*. Hence quantum effects can be expected for every liquid at temperatures of the order 1° K., but are only observable in helium as all other substances become solid at such low temperatures. Landau shows how the actual value of $\triangle$ can be determined from measurements of specific heat and finds that it is 8–9° K. This value is then used for further calculations, for example, of the two velocities of sound.

There are many other interesting investigations which I should like to discuss; but I have first to digest the reprints which were given to me in considerable numbers.

I cannot close this report without expressing my thanks to the Russian colleagues for the kind reception and hospitality we found in their midst.

* Landau's formula should read

$$\hbar^2 \rho^{2/3} m^{-5/3} = \hbar^2 n^{2/3} m^{-2/3} = A^{2/3} \triangle.$$

(To be continued.)

OBITUARIES

Colonel C. H. D. Ryder, C.B., C.I.E.

COLONEL CHARLES HENRY DUDLEY RYDER died on July 13 at Bognor Regis at the age of seventy-seven. He was the seventh son of Colonel Spencer Dudley Ryder and was educated at Cheltenham College and the R.M.A. Woolwich, whence he received a commission in the Royal Engineers. After the usual courses of instruction at Chatham, he proceeded to India and was posted in due course to the Survey of India, in which the whole of his subsequent career was spent.

Much of Ryder's earlier work up to the first World War was carried out on active service or deputation in China, Tibet, Persia and Turkey. Later he was placed in charge of frontier surveys in India, and after taking command of the Survey Service in Mesopotamia during 1917–18, he succeeded Sir Sidney Burrard in the latter year as surveyor general of India, retiring from that post in 1924.

Ryder's greatest contributions to geography were in the field of survey and exploration in China and Tibet. In 1895, not long after joining the Survey of India, he served on the Mekong Boundary Commission, demarcating the Burma-Indo-China frontier. During 1898–1900, with Major Davies, he surveyed most of the routes in the Yunnan Province of China and in parts of Szechwan. Their journeys ended in a voyage down the Yangtse River to Shanghai, and their work forms the basis of present-day maps of these regions. In 1901–2 he was again in China as a survey officer with the Chinese Expeditionary Force. After a brief interval in India, he joined the Tibet Frontier Commission in 1903 and Sir Francis Younghusband's mission to Lhasa (1904). Taking advantage of the newly imposed treaty terms and of the presence of British troops, Ryder was given a free hand to carry out exploration in southern Tibet, and accompanied by Captain Rawling and a very small party he travelled westwards up the Tsangpo valley, exploring and surveying many thousands of square miles of, for the most part, unknown country. They fixed the sources of the Tsangpo, Sutlej and Indus, surveyed Lakes Manasarowar and Rakas Tal, and the region of the holy mountain of Kailas. Their work was controlled by the positions of the Himalayan snow peaks to the south which had been fixed many years previously from the plains of India. A great number of additional peaks were fixed, and the claim that Mount Everest was the highest mountain, in any event in regions hitherto explored, remained unassailed. The expedition reached Simla by way of the Shipki Pass in January 1905; its results form by far the greatest single addition to knowledge of the topography of the Tibetan plateau.

In 1913–14 Ryder served as chief survey officer on the Turco-Persian Boundary Commission, and as deputy commissioner during the absence of Mr. Wratislaw in the later months. The demarcation of this long frontier was complicated by a number of intricate negotiations. For his explorations in China and Tibet Ryder received the Patron's Gold Medal of the Royal Geographical Society, the Silver Medal of the Royal Scottish Geographical Society, and the Gold Medal of the French Geographical Society, and he was awarded the C.I.E. for his work on the Turco-Persian boundary.

C. G. Lewis.

Dr. Catherine Alice Raisin

Dr. Catherine Alice Raisin, a pioneer who blazed many new trails, died at Cheltenham on July 13 at the age of ninety. Her early education was received at the North London Collegiate School, of which she always spoke with gratitude as being one of the earliest schools to start providing more serious education for girls. Miss Raisin continued as a teacher at her old school until 1875, when the opening of certain classes to women students was advertised by University College, London. Among these was a course in geology by Prof. Morris. Miss Raisin attended this class, and so became the first woman to take geology in the University. In the following year she joined Prof. Morris' classes in mineralogy, only to discover after the course was completed that it had not been officially open to women.

In 1878 the degrees of the University of London were thrown open to women, and Miss Raisin at once began to prepare for her B.Sc. After passing the Intermediate Science examination in 1879, she selected geology, botany and zoology as her three subjects. She attended Prof. Bonney's classes in geology at University College during 1880–82, and Prof. Bower's classes in botany. Attracted by Prof. Huxley's work in zoology, Miss Raisin obtained special permission from him, in 1883, to attend his classes at the Royal School of Mines. After graduating B.Sc. with honours in geology in 1884, Miss Raisin continued at University College as a research worker, and at the same time as a voluntary assistant to Prof. Bonney, who was then very much overburdened with work. She received her D.Sc. in 1898, and in 1902 was elected a fellow of University College.

During the years when she was preparing for her degree, Miss Raisin achieved one of her earliest ambitions by founding and organizing a discussion club for women—the Somerville Club—which foreshadowed the youth movement of to-day. The work involved must have seriously interrupted her studies, for when the Club opened in 1880 she had already enrolled a thousand members. Under her inspiring leadership, first as honorary secretary and later as chairman, the Club flourished actively for several years. Meanwhile, other educational amenities for women were being developed in London, and in 1887, having served its initial purpose, the Club was wound up.

During 1886–90, Dr. Raisin was demonstrator in botany at Bedford College for Women. In 1890 she succeeded Prof. Grenville A. J. Cole as head of the Geology Department at Bedford College, a position which she held, together with the headship of the Geography Department, until she retired in 1920. Her outstanding teaching and administrative ability are further evidenced by the facts that she was head of the Botany Department during 1891–1908 and was also vice-principal of the College during 1898–1901. From these additional duties she eventually resigned in order to give more time to the claims of geology.

The originality of Dr. Raisin's teaching was in no respect better shown than in her celebrated lectures on petrographic provinces, which became the more fascinating since they were illustrated by practical work on rock specimens of her own collecting from many of the classic areas of Europe and North America. She was a first-class petrographer, with a firm grasp of the optical properties of minerals—then quite exceptional. Rightly unbound by fashion in petrogenetic thought, as time has shown, she stood almost alone in Britain in stressing the work of Lacroix, Termier and Sederholm on granitization, even at the time when crystal differentiation was beginning to hold the field as a major petrogenetic process.

Dr. Raisin's published work includes a long series of petrological and stratigraphical studies, dealing with rocks from the British Isles, Europe, North Africa and India. Her first paper, concerned with the metamorphic rocks of South Devon, was published in 1887, and is notable as representing an early attempt to recognize and map metamorphic facies. Dr. Raisin is, however, best known for her detailed investigation of serpentines.

In 1893 Dr. Raisin was awarded the Lyell Fund by