The explanation of this phenomenon is unknown, but the risk of misinterpretation thus introduced is clearly great. The value did not again deteriorate significantly until much later, when the plasma value for vitamin A had declined to about 40 I.U. per 100 ml. There did not appear to be any correlation between the value for vitamin A in the plasma and the value for the final rod-threshold until both had deteriorated significantly.

Three different laboratories carried out the blood tests, the samples being distributed by post; their results often varied much for the same sample, but the average of a sufficient number yielded consistent results. All three laboratories agreed that no great reliance could be placed on the result of a single estimation for vitamin A in plasma.

From the thirteenth month of the experiment onwards, P. C. Livingston applied his new technique of rod scotometry to examination of the volunteers. By this method the field of vision was mapped under conditions of dark adaptation with test objects of known very low luminosity¹. The technique confirmed the existence of defective night vision in the three volunteers whose final rod-threshold was raised and cone-rod transition time lengthened. In addition, this method revealed the night vision as defective in five of the other deprived subjects who gave normal readings with the adaptometers of Craik and of Wald and Steven. On treatment with vitamin A or carotene, the scotometry readings returned to normal. Rod scotometry thus seemed to detect deterioration of capacity for dark adaptation earlier than was possible by measurement of the dark-adaptation curve.

There were no objective changes on general clinical examination, or conjunctival changes perceptible with the slit-lamp microscope; there were no changes in the blood picture or platelet count. Only one subject showed follicular hyperkeratosis, but a study of the case history indicated that the condition was present from the start and was not specifically affected by variations in the vitamin A supply. There were no definite changes in response to memory and fatigue tests. There was no consistent loss of weight.

Absorption tests. A comparison of the dietary and faecal carotene for the volunteers receiving a carotene supplement showed that the disappearance of carotene from the gastro-intestinal tract was highest when the carotene was dissolved in fat (arachis oil or margarine); on the average, 28 per cent of carotene given in this form was excreted. The percentage excretion of carotene from green vegetables (cabbage or spinach) was in the region of 60, and from sliced carrots in the region of 75. The individual variations were wide.

Requirement of vitamin A and of carotene. Seven volunteers without previous depletion received, for periods of from six and a half to twenty-two and a half months, a daily supplement of about 2,500 I.U. vitamin A as distilled natural esters in oil, or of about 5,000 I.U. carotene, in oil or from various natural sources, and showed no changes attributable to vitamin A deficiency.

The three subjects who developed defective night vision and low plasma values for vitamin A were dosed with vitamin A or β -carotene in oil while the deficient diet continued. In one case treatment with a daily dose of 1,300 I.U. vitamin A restored dark adaptation and plasma vitamin A values to normal levels within five months. A second case did not respond to a dose of 1,300 I.U. carotene daily but improved in the course of five months when the dose

was changed to one of 2,600 I.U. daily. In the third case, where the degree of deficiency was milder, a daily dose of 2,600 I.U. carotene promptly improved dark adaptation and the concentration of vitamin A in the plasma.

When the amount of carotene excreted was deducted, the amount of vitamin A and of carotene which brought about the same result would thus appear to be about the same.

For assessing the requirement the relevant results are the following:

A daily dose of 1,300 I.U. vitamin A or of 2,600 I.U. carotene was sufficient to cure a mild state of vitamin A deficiency. The body reserves of vitamin A, presumed as already mentioned to have had a median value of about 600,000 I.U., were sufficient in all sixteen deprived subjects to prevent the onset of definite signs of vitamin A deficiency for from twelve to twenty months; such a reserve would correspond with an average rate of consumption of 1,300 I.U. daily for fifteen months.

Thus, inclusion in the diet of a daily dose of 2,500 I.U. vitamin A, or of 5,000 I.U. carotene, may be regarded as adequate for maintenance of normal human adults and as leaving a fair margin of safety.

The following members of the Vitamin A Sub-Committee, Dr. K. H. Coward, Miss E. M. Hume (secretary), Dr. S. K. Kon, Dr. T. Moore and Prof. R. A. Morton, formed part of a team which included Mr. W. C. Bartley, Prof. H. A. Krebs, Dr. K. Mellanby and Dr. J. Pemberton, each of whom undertook responsibilities in Sheffield and, with Mr. T. W. Goodwin, Dr. H. M. Sinclair and Miss C. M. Wood, participated in the work and in the regular meetings concerned with the conduct of the investigation. Many other workers, whose contributions will be recorded in the full report, supplemented the work of the Sub-Committee.

¹ Livingston, P. C., *Lancet*, 1, 33 (1944).

OBITUARIES

Prof. Alexander Fersman

PROF. ALEXANDER FERSMAN, the distinguished Russian mineralogist and geochemist, died on May 20 at the age of sixty-two. The death of his former teacher, Prof. V. I. Vernadsky, a brilliant investigator in the same field, occurred a few months earlier¹. The double loss is a grievous blow to the science of geochemistry, for both men occupied the leading positions in the vigorous Russian schools of geochemical studies of which a short account was given recently in the pages of *Nature*².

For the present notice on Fersman's work, some data have been drawn from a note supplied by Prof. A. Vinogradov, of the Academy of Sciences, Moscow.

Graduating from the University of Moscow in 1907, Fersman first worked in the laboratory of Vernadsky. He was ultimately to become director of the Lomonosov Institute of Mineralogy, Crystallography and Geochemistry in Moscow, a new institute founded in recent years by the fusion of four departments of the Academy of Sciences of the U.S.S.R.

Fersman's early researches were essentially crystallographic and mineralogical: he worked in Paris and Heidelberg and travelled in Switzerland

and Italy, eventually contributing a paper on the mineralogy of Elba. He was co-author with V. Goldschmidt of Heidelberg of an elaborate memoir on the crystal morphology of the diamond, and later produced an authoritative treatise on the precious stones of Russia.

In 1912 Fersman was appointed to a professorship in mineralogy and to a curatorship of the Museum of Mineralogy attached to the Academy of Sciences. From this time his interests were to be devoted to the field of geochemistry. There were to follow during the next twenty-five years his monumental works on geochemistry, and while it is still too early to assess the value of some of the daring theoretical treatment his exuberant genius brought to the interpretation of the factual data, experimental and observational, which he had amassed, his rank as a leader of international reputation has rested on brilliant achievement over a wide field. Between the two World Wars his contributions included detailed investigations on the geochemistry of pegmatites, particularly those of granite and alkali-syenite type; researches on the geochemical migration of elements within sedimentary terrains remote from magmatic centres, and numerous other studies in regional mineralogy.

Many geological expeditions fostered by the Academy of Sciences within the vast territories of the U.S.S.R. were organized under his leadership, and he personally conducted explorations in Central Asia, the Urals and the Kola Peninsula. These investigations led to highly important economic developments, notably with the discovery of great apatite deposits of magmatic origin in Kola and of large workable deposits of sulphur in the Kara-Kum desert of Transcaspiia.

Of Fersman's many achievements, his researches on the great alkali igneous complexes of Khibin and Lovozero in the Kola region rank among the most outstanding. In the elucidation of these unique intrusions, Fersman's own studies were dominant. They have greatly widened our knowledge of the chemistry and mineralogy of alkali magmas and of the conditions controlling the peculiar sodic (agpaite) type of differentiation.

As director of the Khibin Scientific Arctic Station near Kirovsk, Fersman inspired much of the later work of his younger colleagues in the same field, and it was under their guidance that the participants in the Kola Excursion of the 1937 International Geological Congress were able to appreciate to the full the magnificent pioneer researches linked with his name.

Fersman's most important memoirs, including his works on geochemistry (four vols., 1933-37), pegmatites (1931, 1940) and other studies in regional mineralogy, are in Russian. In English, his "Scientific Study of Soviet Mineral Resources" (1935) provides a succinct account of the planning and development of the mineralogical researches in which he himself played so prominent a part.

In addition to his scientific work—he was author of some five hundred scientific books and papers—Fersman was active in public life. He had a gift for the exposition of scientific knowledge in popular form, and his artistic sense was shown in his articles about chemical elements, minerals and rocks. Member of the presidium of the Academy of Sciences, he was at one time chief editor of its scientific publications.

Fersman was the recipient of a Stalin Prize and was awarded the Order of the Red Banner of Labour by the Soviet Government. Abroad, his honours

included foreign membership of the American and British Mineralogical Societies and the award of the Wollaston Medal of the Geological Society of London in 1943.

C. E. TILLEY.

¹ *Nature*, **155**, 296 (1945).

² *Nature*, **154**, 814 (1944).

Sir Martin Forster, F.R.S.

THE death in Mysore City on May 24 at the age of seventy-two of Martin Onslow Forster has removed from our midst an organic chemist who, prior to 1922, was an outstanding figure in British chemistry. Forster received his early education at Dover Hill House, Margate, and having decided upon a chemical career he entered the Finsbury Technical College, where he received an excellent training under the late Prof. R. Meldola. As was customary at the time, when the opportunities for research in Britain were somewhat limited, he proceeded to Germany, where he worked at Würzburg under Prof. E. Fischer. The debt which Forster owed to him was in some measure repaid by the brilliant memorial lecture which he delivered to the Chemical Society in October 1920. Returning with his Ph.D. degree, Forster in 1894 came under the influence of Prof. H. E. Armstrong, in whose laboratory he worked as the holder of a Salters' Research Fellowship, and so arose a life-long friendship. His tenure of the fellowship was short, since in 1895 he was appointed by Sir William Tilden to a demonstratorship in chemistry at the Royal College of Science, and there followed a period of amazing scientific activity which rapidly placed Forster in the front rank of British organic chemists.

For many years Forster's investigations were confined almost entirely to the chemistry of camphor, on which subject he published more than thirty memoirs under the general title "Studies in the Camphane Series". Many of these are now only of historic interest; but his work on β -bromocamphor and on the oximes of camphor and *epicamphor* are of lasting value, and the latter form a remarkable contribution to stereochemistry. In 1907, he broke new ground when, in collaboration with H. E. Fierz, the first of a long series of papers on the triazo-group appeared. This work, which was not devoid of personal risk and actually resulted in grievous injury to one of his research students, was actively pursued until 1913, when he resigned his appointment at the Royal College of Science, having been an assistant professor since 1902. Almost all Forster's papers were communicated to the Chemical Society, and they are notable for the clarity and brilliance of their exposition. This latter quality was not confined to the written word, since it was generally regarded as a 'field-day' when Forster read a paper at one of the Society's meetings.

Forster's resignation and his decision to enter politics somewhat surprised his friends, and was undoubtedly due in part to his disappointment at not having been appointed to a full professorship. The outbreak of the War in 1914 brought Forster back to chemistry and in 1915 he was appointed a director of British Dyes, Ltd., a post which he held until 1918. In these critical years he served British chemistry well. His activities were not confined to the technical side of the industry; he was mindful of the importance of social amenities for the staff, being responsible for the first staff club at Huddersfield. During 1918-22 he filled the newly created post