practical purposes. If experimentation shows flaws in the theory, then it is necessary (according to the facts of the case) to study more carefully, trying various improvements until as satisfactory a hypothesis is obtained as possible. If one still fails, the reasons for failure must be further inquired into, and corrections made accordingly. The ideal type of research worker is one who stands firmly by the scientific attitude (the objective outlook), observes facts and circumstances objectively and with humility, and draws his conclusions therefrom. Then only will there be any hope of knowing the truth.

Analysis and Statistics. When any plan or project of work shows development at the experimental stage, whether good or bad, one must collect and analyse the mass of material on hand, find out where the defects or good points are, decide whether the plan is workable and how far progress has been made, and in which direction and along what lines future developments are to take place. This statistical and analytical ability and the power for precise decision are fundamental in the success or failure of our research or practical work. Without the analytical and decisive mind it will not be possible to see clearly and objectively the relevant facts, and one falls into a mental state of chaos and disorder, failing to discover any likely approach to a successful conclusion.

Improvements and Inventions. To be conscious of mistakes is the most important factor in making progress. So in all our analytical examinations it is imperative to find the causes of these mistakes; only in this way shall we be able to find the required improvements. We must also persevere to discover those new principles, new methods, and new factors which are essential for general progress.

Conclusions. We live in an era of difficulty, suffering and danger. To be able to shoulder the heavy responsibility of reviving our nation and completing our revolution, we must have at all costs a clear idea of the content and meaning of science; we must propagate the spirit of science; and we must utilize the methods of science; so that one man will be as efficient as ten, and in one day ten days work will be done. While we are fighting intensely at the front for the mode of life we want, we cannot remain stationary at home; if we do not progress we shall degenerate; if we cannot achieve success we shall be ruined; if we do not prosper we shall be crushed; if we still refuse to gather our full strength our very existence will become impossible. From this day onwards, whatever it is we have to do, and whoever is doing it, there should be no more inefficient half-heartedness and no more spirit of fatalistic resignation.

OBITUARIES

Prof. David Hilbert, For.Mem.R.S.

NEWS has reached Great Britain that Prof. David Hilbert, of Göttingen, died recently. He was born on January 23, 1862, and was a mathematician of tremendous power who ranged over a wide field and had an unusual influence on present-day mathematics. An indication of the breadth of Hilbert's influence is the number of mathematical topics which are associated with his name. For example, we have Hilbert space, Hilbert inequality, Hilbert transform, Hilbert invariant integral, Hilbert irreducibility theorem, Hilbert base theorem, Hilbert axiom, Hilbert sub-groups, Hilbert class field. Again we recall his contributions to the "Yellow-Backs": "Methoden der Mathematischen Physik" (with Courant), "Grundlagen der Mathematik" (with Bernays), "Anschauliche Geometrie" (with Cohn-Vossen), "Theoretische Logik" (with Ackermann).

The fact that Hilbert was able to produce outstanding original results in a large number of different branches of mathematics and mathematical physics is most remarkable in our times. It was made possible by his ability to concentrate completely on one subject for a time; when he had finished, he rarely returned to it or even cared to hear about it, not even recognizing his own results. However, when Hilbert did become interested in a subject, he was able to indicate so many possible lines of development that mathematicians were kept busy for decades afterwards on new problems.

There can be few mathematicians nowadays whose work does not in some way derive from Hilbert. His personality and naïve enthusiasm attracted to Göttingen many pupils and followers who will always delight in recalling their experiences there and in passing on some of the Hilbert anecdotes. Hilbert's devotion to mathematics was complete: he allowed no prejudices, racial or otherwise, to interfere. For example, despite violent opposition from his colleagues, during the War of 1914–18 he insisted on delivering a eulogy on Darboux and on Emmy Noether receiving the *venia legendi* at Göttingen.

While it is not possible to give here an account of Hilbert's work, it is worth while recording some of the main topics on which he concentrated at various periods: invariant theory, algebraic number theory, diophantine equations, integral equations, foundations of geometry, mathematical physics, calculus of variations, foundations of mathematics. A detailed study of his papers reveals the continuous development of his thought from "theology" back to "theology". In honour of his seventieth birthday a three-volume edition of his papers was published. Reviews of the volumes by Prof. L. J. Mordell, to which those who wish for a more detailed account of his work should refer, appeared in the *Mathematical Gazette* in 1932, 1934 and 1936. I had the privilege of being closely associated with Hilbert in the preparation of this edition. In conversation, Hilbert often affirmed that, much as he admired every branch of mathematics, number theory was for him the most attractive. By number theory he meant algebraic number theory rather than the number theory typified by Waring's theorem, for which he nevertheless found the first proof and by which he is perhaps best known in Great Britain to-day. His work on Waring's problem was totally unconnected in content and time from his main work on number theory. It is interesting to recall that, in connexion with a lecture by Prof. R. Fueter at the 1932 Zurich Congress, Hilbert asserted that the theory of complex multiplication (of elliptic modular functions) which forms a powerful link between number theory and analysis, is not only the most beautiful part of mathematics but also of all science.

Among Hilbert's papers, I will mention only a lecture in Paris in 1900, in which he stated his famous series of twenty-three problems. These were the problems which he considered most significant in mathematics at that time; not isolated questions but problems of such a general character that their

solution was bound to have an enormous influence on the shape of future mathematics. The present time seems an opportune one, since so many mathematicians have given up their usual sort of mathematics, for another Hilbert to state the present position of the original problems, and to present a new series and thereby to orient the activities of mathematicians of the future.

OLGA TAUSSKY.

Dr. T. T. Groom

THOMAS THEODORE GROOM was born at Wellington, Shropshire, on May 16, 1863, and died in Oxford on March 26, 1943. After studying at the University of Heidelberg and University College, London, he entered St. John's College, Cambridge, in 1885 with an exhibition, and was afterwards awarded a foundation scholarship. He obtained a first class in the Natural Sciences Tripos Part 1 in 1887 and in Part 2 (Geology) in 1889, and gained the Harkness scholarship for geology and palæontology. In the same year he took first-class honours in the examination for the London B.Sc.

Groom's first post was as demonstrator in zoology at Leeds under Prof. L. C. Miall. He next became professor of natural history at the Royal Agricultural College, Cirencester. In 1899 he left Cirencester for University College, Reading, where he was lecturer in geology and zoology. In 1906, at the invitation of Prof. Lapworth, he went to Birmingham as lecturer in geology, and remained there until Lapworth's retirement in 1914, when he moved to Oxford, where he spent the rest of his life.

At first Groom's interests seem to have been equally divided between geology and zoology, but eventually the attractions of geology prevailed. Although his qualifications in both geology and zoology seemed to fit him especially for research in palæontology, his principal work was in field geology.

While still an undergraduate, Groom wrote a paper on the corallian echinoid Pelanechinus, of which he discovered one of the only three specimens known. By a detailed study of its structure he brought forward new evidence to show that this genus belongs to the Echinothuridæ, of which it is the earliest representative, living forms being found in the deep sea. In Pelanechinus he proved, for the first time, the existence of pedicellariæ in fossil echinoids.

After taking his degree at Cambridge, Groom spent a year at the Naples Zoological Station and investigated the early stages in the development of Cirripeds. The results of this work, for which he was awarded the D.Sc. of London, were published in the *Philosophical Transactions of the Royal Society*, **185** (1895), and *Quarterly Journal of Microscopical Science*, **37** (1895). Of Groom's work in geology his unravelling of the complex tectonics and geological history of the Malvern and Abberley Hills is of outstanding merit. The results of this investigation were published in a series of papers during the years 1899 to 1902 (*Quart. J. Geol. Soc.*, **55**, **56**, **57**, **58**) and a general summary of the work, including the Ledbury district, was given in "Geology in the Field" (1910), p. 698. In collaboration with his friend, Philip Lake, Groom wrote on the geology of the Silurian districts of Corwen and Glyn Ceiriog in North Wales (*Quart. J. Geol. Soc.*, **49**, 64).

Groom's interests were wide. In palæontology, in addition to the early paper on Pelanechinus, he described new Cambrian hyolithids, trilobites and ostracods (1902), while in petrology he wrote on the igneous rocks associated with the Cambrian of the Malvern Hills (1901) and on a tachylite from Carrock Fell (1889). In geomorphology he gave an account of the effects of faults on the character of the sea-shore (1895). From 1907 until 1917 Groom spent much time in investigating the beds forming the boundary of the Silurian and Old Red Sandstone in the Llandeilo and other districts of South Wales. It is greatly to be regretted that this work was left unfinished and no account of it published. After 1910 his only publication was a short paper, in conjunction with W. K. Spencer, on Ordovician starfishes which he had discovered in Shropshire (*Geol. Mag.*, 1934). Groom was a stamp collector and made some contributions to the literature of philately. His notebooks, zoological preparations and a few rock-slices were bequeathed to the Sedgwick Museum, Cambridge. The main part of his geological collection was left to the University Museum, Oxford. Owing to his long retirement from active work, Groom was personally but little known to the younger geologists of to-day. Those of his contemporaries who survive cherish the remembrance of a good friend and a genial companion.

H. WOODS.

Dr. E. C. V. Mattick

DR. ELFREIDA C. V. MATTICK (*née* Cornish) died in Reading on July 19, 1943. She was educated at Colston's School, Bristol, and took her qualifying degrees at the University of Bristol, working with Prof. J. W. McBain on a thesis dealing with the colloidal properties of soap solutions. She later took her doctorate at the same University. But she will best be remembered for her very long association with the National Institute for Research in Dairying at Shinfield, where she took up work on a Ministry of Agriculture Scholarship in 1913. For thirty years, but for a few months, she worked at Shinfield; in earlier years with Dr. Stenhouse Williams and Mr. J. Golding on the effects of heat treatment on the nutritive value of milk and later on the chemical changes taking place in the ripening of cheese, on the fat-splitting enzymes present in milk and milk products, on vegetable sources of rennet and on many other chemical and biochemical problems of practical importance in dairying.

Her first husband, Mr. Lionel Venn, was killed very shortly after her marriage during the War of 1914–18. Later, she married Dr. A. T. R. Mattick, now head of the Bacteriology Department at Shinfield.

During the last years of her life Dr. Mattick suffered from very bad health, but her enthusiasm for research and unfailing courage gave her the strength to continue her investigations in the laboratory until only a short time before her death. This triumph of a resolute mind over a failing physique was noted and admired by her colleagues, and her own slowly progressing illness never disturbed that kindliness and consideration for others for which she will long be remembered by all who knew her.

G. W. SCOTT BLAIR.

WE regret to announce the following deaths:

Sir Stopford Brunton, Bt., the well-known Canadian mining geologist, on July 25, aged fifty-eight.

Prof. J. Gibson, emeritus professor of logic and philosophy in the University College of North Wales, Bangor, on August 1, aged seventy-eight.