It is, of course, impossible to compare readily the results of two techniques so different, especially as the full details of the Russian work are not yet available.

In conclusion, it seems now fair to say that the interaction between adenylpyrophosphatase and its natural substrate brings about deep-seated and optically observable effects upon the enzyme's physical state. Whether these changes are micellar in character, or whether they are analogous to the configurational changes established for the keratins, remains as yet uncertain. Could adenylpyrophosphate itself then be normally *in vivo* the agent of contraction ? Were this so, the reception of the nervous or other stimulus would essentially allow the enzyme and substrate to come in contact. By this enzyme-substrate combination the configuration of the contractile enzyme would itself immediately be changed (as pictured by Astbury and Dickinson[19]; Astbury[20]), and the later splitting off of inorganic phosphate from the substrate would supply the energy needed for the relaxation and recharging of the myosin fibril. The solution of these problems will be of much importance, not only for muscle physiology, but also for many other fields of biology into which fibre-properties enter, such as morphology and morphogenesis (cf. the recent work of Pollister[21] and Hobson [22]).

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OBITUARIES

Prof. A. R. Forsyth, F.R.S.

PROF. ANDREW RUSSELL FORSYTH, emeritus professor of the Imperial College of Science and Technology, South Kensington, died on June 2 at Bailey's Hotel, London, where he had lived since he retired in 1923 from his position as chief professor of mathematics at the Imperial College. His age just fell short of eighty-four, as he was born (at Glasgow) on June 18, 1858.

He was educated at Liverpool College and at Trinity College, Cambridge. His student career at Cambridge was brilliant: he was Senior Wrangler, and First Smith's Prizeman in 1881, in which year also he was elected to a prize fellowship at Trinity. In the following year he became professor of mathematics at University College, Liverpool, but two years later, in 1884, he returned to Cambridge as a lecturer of his college and of the University. In 1895 he became Sadleirian professor of pure mathematics at Cambridge in succession to Cayley, whose voluminous collected papers he edited (1895–98).

While still in his twenties Forsyth attained a reputation as a pure mathematician that extended far beyond the borders of his own university and country. His distinguished researches, an account of which is given separately below, led to his election as a fellow of the Royal Society at the early age of twenty-seven, and eleven years later he was awarded a Royal Medal of the Society. In the same year he was president of Section A of the British Association at its Toronto meeting, a distinction which he held a second time in South Africa in 1905. He was president of the London Mathematical Society during 1904–6.

Besides making important original contributions to pure mathematics, Forsyth rendered a service of special value to his university in breaking the bonds of the isolation of its mathematical school, during the latter part of the nineteenth century, from the great Continental movements of thought in the subject. By his writings and his lectures he widened the knowledge and outlook of his colleagues and students, and stimulated a revival of pure mathematical learning and research in England.

Forsyth was a prolific author of books, beginning in 1885 with a text-book on differential equations, that has run through many editions, and has been translated into several languages; this was followed by a large treatise on the theory of differential equations, in several volumes (1890–1906), and by an attractive text-book on the theory of functions (first edition in 1893).

During his Cambridge period he found time also to take part in the government of the University, as a member of the Senate during 1890–1910; and in other public work, for example, as a member of the Treasury Committee on the Scottish Universities, in 1909.

For many years Forsyth was regarded abroad as the leader and representative of English pure mathematics, and honours from universities and academies the world over were bestowed upon him. He maintained many personal and official international contacts; he travelled much and was an accomplished linguist.

In the midst of his fame he left Cambridge (1910), resigning his chair and the college fellowship that meant so much to him. In painful circumstances he made a marriage of affection, and gained ten years of a happiness for which he counted the loss of many old associations a price not too high. For a time he was without any official position, and during this period he delivered in Calcutta (1913) a series of lectures on differential geometry (afterwards published as a book).

Forsyth entered on the last phase of his teaching career when in 1913 he accepted the headship of the department of mathematics at the Imperial College, combining the direction of two previously separate schools (one in the Royal College of Science, the other

in the City and Guilds Engineering College) headed by Profs. Perry and Henrici, who retired nearly at the same time. The War of 1914–18, and its aftermath, interrupted his plans for building up a new honours school of mathematics at South Kensington, and he retired from his chair in 1923, after ten years tenure, on attaining the age limit of sixty-five.

His wife had died of cancer not long before, to his intense grief; he cherished her memory most tenderly, and in his will he left his residuary estate to the Royal Society for cancer research.

In his lonely retirement Forsyth found solace in his mathematical studies, and published two further treatises, on the calculus of variations (1927) and the geometry of four dimensions (1930); he also continued his linguistic studies.

His last years were clouded by frequent illness. His thoughts dwelt much on his Cambridge days, particularly on the old-time Tripos conditions of his student period, and on the Senior Wranglers of those years. In his last illness his mind lived in this golden epoch of his youth.

S. CHAPMAN.

THE old Tripos admitted of very little specialization, and a Senior Wrangler was bound to have a competent knowledge of every branch of mathematical science known to the Cambridge of his day. The emphasis was generally on mathematical physics, in which England led the world; and Forsyth's first original paper—written when he was still an undergraduate—was on the motion of a viscous incompressible fluid. Immediately after taking his degree, he began to work on a fellowship dissertation; for some time he toyed with the kinetic theory of gases, but finding this unprofitable, he turned to an idea which had occurred to him when listening to Glaisher's advanced course on elliptic functions, and in two months produced the great memoir on the double theta functions, which occupies 79 pages of the *Phil. Trans.*, **173**, and which, besides winning the fellowship, laid the foundation of his fame as an original investigator.

The subject was well suited for the display of Forsyth's most characteristic gifts: a masterly algebraical technique in dealing with vast numbers of symbols, and a wonderful power of detecting identities and relations in problems of great complexity. In the following year he wrote a long and valuable paper on a closely related subject, Abel's theorem and Abelian functions, which was printed in *Phil. Trans.*, **174**, and after this a substantial work on the Weierstrassian doubly periodic functions (*Quart. J. Math. Soc.*, **22**), which he introduced to Cambridge mathematicians (Glaisher always adhered to the Jacobian *sn*, *cn*, *dn*). It is somewhat remarkable that although a pupil and fervent admirer of Cayley, he had up to this time done nothing on Cayley's great subject, the invariant-theory of algebraic forms; and when he did come to it, in 1887, it was not directly but by the roundabout way of differential equations. In a single year, 1889, he published five papers, totalling 284 pages, on the concomitants of algebraic and differential forms; and in the next year, more than a hundred pages in the *American Journal of Mathematics* on a topic in the same field, "Systems of ternariants that are algebraically complete".

The following years were spent chiefly in preparing himself for writing a book which had perhaps a greater influence on English mathematics than any work since Newton's "Principia", namely, the "Theory of Functions of a Complex Variable", which was published in 1893. This for the first time opened to his countrymen the vast development of pure mathematics which had taken place on the Continent in the nineteenth century; it broke the Cayley tradition, and led all the younger generation at Cambridge into the new domain. On Forsyth's part it was a patriotic and self-sacrificing action; for while the fresh impetus brought vigour and fame to the school, the situation was not well suited for the exercise of his special aptitudes: there was little opportunity of superb generalship with symbols, and his somewhat unphilosophical mind was at a disadvantage when confronted with the new type of problems. Moreover, by turning everyone's attention away from the subjects in which his greatest triumphs had been won, he caused what was in effect a lowering of his own popular reputation.

Another factor which perhaps likewise tended in some degree to displace Forsyth from the supreme position which he held in the general estimation at the end of the nineteenth century was the practice, which he adopted from this time onwards, of publishing most of his discoveries, not as they were made, in separate papers, but in advanced treatises (some of them of colossal size), each summing up the work of several years. Human nature being what it is, a worker on the remotest frontier of pure mathematics would probably be well advised to impart his results to the world by instalments smaller than those customary with Forsyth; few people are willing to tackle what is practically a continuous heavily analytical original memoir of eight hundred pages. But whatever may be thought of the practical wisdom of his later policy, the great memoirs of his earlier period will secure for him permanently one of the high places in the mathematical pantheon.

E. T. WHITTAKER.

Mr. W. A. Benton

WE regret to record the sudden death of William Alfred Benton at his home at Handsworth, Birmingham, on June 19, at the age of seventy-one. For many years Mr. Benton was in charge of research at Messrs. W. and T. Avery Ltd., Soho Foundry, Birmingham, and was a well-known figure in scientific circles. He was a fellow of the Physical Society and a past president of the Birmingham Metallurgical Society; among other activities he was a member of the Society of Chemical Industry, the Newcomen Society and the Wolverhampton and District Society. During the past few years Mr. Benton had been compiling a work on the history of the balance, and it is fortunate that the greater part has already been completed.

Outside his professional interests, Mr. Benton was a keen amateur photographer, and was a member of the Royal Photographic Society and local photographic societies.

WE regret to announce the following deaths:

Mrs. F. Rhys Davids, president and co-founder of the Pali Text Society, on June 26, aged eighty-four.

Lord Glanely, president of the University College of South Wales and Monmouthshire, at Cardiff, on June 28, aged seventy-four.

Sir Daniel Hall, K.C B., F.R.S., formerly director of the John Innes Horticultural Institution, and for some years chief scientific adviser to the Ministry of Agriculture, on July 5, aged seventy-eight.