might be identical with the anti-pernicious anæmia factor of liver. Finally, Stokstad and others showed that the animal protein factor could be elaborated by suitable micro-organisms and that the bacterial product was effective in pernicious anæmia. This discovery opened a way for production of vitamin B₁₂ by fermentation methods similar to those used for making antibiotics. Indeed, it was announced at the end of 1948 by the Merck group that a strain of *Streptomyces griseus* (the organism used for streptomycin production) produced vitamin B₁₂.

The presence of cobalt in vitamin B₁₂ seemed at first to link this substance with the known requirement of ruminants for traces of cobalt in their diet. Any direct connexion was disproved, however, by the discovery that vitamin B₁₂ was ineffective for sheep on a cobalt-deficient diet. Nevertheless, a less direct connexion may be postulated. It seems that the cobalt is required not directly by the animal but by the rumen bacteria, which play a large part in ruminant digestion. It is likely that these bacteria utilize part of the cobalt to synthesize vitamin B₁₂, which then finds its way into the liver of the animal.

The second paper, on bacteriological aspects, was given by Dr. D. D. Woods, of the Department of Zoology and Comparative Anatomy, Oxford, who pointed out that micro-organisms have played a worthy part in this work. All the well-characterized members of the vitamin B group, including folic acid and vitamin B₁₂, are now known to be essential growth-factors for some micro-organism or other. By no means all bacteria require all these factors; broadly speaking, when a factor is not required, this means that the organism concerned is capable of synthesizing it. Thus it is true of both folic acid and vitamin B₁₂ that certain micro-organisms require them and can therefore be used in their microbiological assay, whereas other organisms synthesize useful amounts of the factors and could be used for their production.

Microbiological assays have several advantages over the alternative animal assays for folic acid, or clinical assays for vitamin B₁₂. Thus the deficient media are relatively easy to prepare. The criterion—namely, growth of the organism or its absence—is simple in comparison with the assessment of symptoms in higher animals. Finally, there is usually a clear-cut relationship between dosage and response, and results are obtained quickly, often within twenty-four hours. On the other hand, it so happens that folic acid, and also vitamin B₁₂ especially, are among the most difficult factors to assay microbiologically. The organisms usually employed for vitamin B₁₂ assay are certain micro-aerophilic lactobacilli; since these do not require vitamin B₁₂ at all for purely anaerobic growth, quantitative response depends on the degree of aeration of the medium and careful control of the concentration of reducing agents.

Factors in the vitamin B group are required not only by bacteria and animals, but also by fungi, protozoa, insects, birds and higher plants. One may therefore conclude that they are essential metabolites for all types of cell. It follows that in studying their function one may use any convenient organism, and in practice micro-organisms are often the most convenient. The picture is still far from complete, but there are indications that folic acid may have a function in the biosynthesis of pyrimidines, thymine (a constituent of desoxyribonucleic acid) and possibly purines, such as adenine. It is also probable that folic acid functions as part of the structure of the

coenzyme involved in these syntheses. It is possible that folic acid, which contains a *para*-aminobenzoic acid residue, may function like the latter substance in the biosynthesis of certain amino-acids. For vitamin B₁₂ the evidence is still less complete, but there are indications that it may be involved at some stage in the biosynthesis of desoxyribosides, possibly for the synthesis of the desoxyribose moiety or for its attachment to the purine or pyrimidine.

The concluding paper of the session, by Dr. C. C. Ungley, of the Royal Victoria Infirmary, Newcastle, was on clinical aspects. Dr. Ungley has assayed on some eighty patients the liver fractions that were used in the isolation of vitamin B₁₂ in Great Britain. His paper, however, concerned the findings on some fifty patients treated with the pure crystalline compound at various dose-levels. Confirming previous findings with liver extracts, the reticulocyte response proved a somewhat unreliable index. The increase in red blood cells conveniently assessed at the fifteenth day was much more closely related with dose. The expected response is a function of the initial level of red cells, but a statistical method was evolved to adjust the responses to a 'theoretical' initial level of two million.

It was then found that on average a single dose of 10 µgm. would produce the 'expected response', according to the accepted formula, but that larger doses gave greater responses, which were roughly proportional to the logarithm of the dose in the range 5–80 µgm. For maintenance, doses of 10 µgm. every two weeks gave satisfactory results in nearly all patients. No fresh neurological symptoms developed in any of the patients maintained for periods up to fifteen months on vitamin B₁₂, while cases of already established subacute combined degeneration of the spinal cord improved after continued dosage with vitamin B₁₂, and to the same degree that would be expected from dosage with active liver extracts. Dr. Ungley also reported several cases of macrocytic anæmia of pregnancy that responded to folic acid after failing to respond to vitamin B₁₂.
E. LESTER SMITH

OBITUARIES

Dr. A. P. Laurie

It is difficult nowadays to think back to the time when it was considered eccentric to apply the tools of the scientist to the problems of the artist—when there was no laboratory, no group of research physicists and chemists, at the National Gallery, the Louvre, the British Museum, the Courtauld Institute of Art, the Fogg Art Museum. These, and their counterparts elsewhere, owe much to one bold pioneer—Arthur Pillans Laurie, whose death on October 7 at the age of eighty-seven has deprived them of their doyen.

Born on November 6, 1861, near Edinburgh, the son of Prof. S. S. Laurie, he was educated at the Universities of Edinburgh and Cambridge. His early scientific interests lay in the field of electrochemistry; he worked on the E.M.F. of alloys in voltaic cells and kindred problems, and obtained a D.Sc. at Edinburgh. He had a keen appreciation of the fine arts; and an early contact with Holman Hunt directed his scientific interests towards the materials of the craftsman. Although he specialized in the materials employed in painting and the graphic arts, and

became an accepted authority on the technical methods of the Old Masters, his interests extended to other crafts; and his little book, "Building Materials" (1922), takes an honourable place beside his better-known works: for example, "The Pigments and Mediums of the Old Masters" (1914), "The Painter's Methods and Materials" (1926), and "The Brush-work of Rembrandt and his School" (1932).

Laurie developed many ingenious methods of investigating pigments and media on the micro scale, at a time when microchemistry had not yet become an orthodox technique, and he figured prominently in so many *causes célèbres* on the authenticity of Old Master paintings that his eminence in this sphere is in danger of obscuring the catholicity of his other interests. As a young man he worked in White-chapel under Canon Barnett, at Toynbee Hall; clubs, theatres and gardens for the young East Ender, and a precarious little factory for improved artist's colours, all engaged his energies at this time. A fervid Liberal and friend of Lloyd George, he once contested unsuccessfully a Liberal seat in his native city. He was principal of the Heriot-Watt College, Edinburgh, during 1900-28, difficult formative years; and the impressive development of the College owed much to Laurie's devoted labours. In 1912, to his great delight, the value of his researches on the artist's materials was recognized by his appointment as professor of chemistry to the Royal Academy of Arts.

Laurie was a character. Straightforward and honest to a fault; burly in figure, brusque and gruff in manner; scholar, humanitarian, lover of the arts; pugnacious, full of vitality, stubborn and argumentative, generous and kindly; a good talker on any topic, but most of all on pictures; the ever-probing investigator, a good friend, and a stimulating antagonist; a man intensely individual and unorthodox, authoritarian yet himself impatient of authority—these are some of the memories of him which persist most vividly. On his favourite topic he wrote as he talked—rapidly, staccato, with confident authority and little inclination to revise, prune and polish; but his matter was of such novelty and interest that it was easy to forgive the brilliant *non sequitur* which now and then delighted the reader.

It caused, perhaps, less surprise than distress to the friends of this robust and authoritarian old scholar when, in his seventies, he took up the cudgels on behalf of the Nazi philosophy, even to the publication of a spirited defence thereof, "The Case for Nazi Germany". This lost him friends; characteristically, however, he did not swerve from views honestly held, however unpopular.

P. D. RITCHIE

Prof. Alexander Meek

ALEXANDER MEEK, who died on November 2, was born at Broughty Ferry in 1865. He was for many years, until his retirement in 1932, professor of zoology at Armstrong College (University of Durham) and director of the Dove Marine Laboratory. After leaving school, he studied art and then determined to become a scientific worker. He spent a year at the Royal College of Science and then entered University College, Dundee, as a student under Prof. D'Arcy Thompson. For two years after graduating in 1889 he worked at the Gatty Marine Laboratory under Prof. W. C. McIntosh. He was then appointed county council lecturer in agricultural zoology in Aberdeen-

shire. He held this post until 1894 when he obtained a lectureship in veterinary anatomy and farm hygiene at what was then the University of Durham College of Science, later to become Armstrong College and, still later, although not in his time, to be merged in the present King's College.

After his appointment at Newcastle, his interest again turned to marine zoology, and, in 1898, he was appointed to a demonstratorship in the Department of Natural History without, however, severing immediately his connexion with agriculture. He was fortunate in working under Prof. G. S. Brady, who had written the reports on the Copepoda and Ostracoda of the *Challenger* Expedition and who knew or had known the local 'giants' of marine zoology such as Joshua Alder, Albany Hancock, Canon A. M. Norman and many others. He succeeded Brady in the chair of zoology in 1908.

In this environment Meek flourished. In 1897 the Northumberland Sea Fisheries Committee published his first "Report on the Trawling Excursions carried on during the Summer of 1897 and on the Marine Laboratory at Cullercoats". The Marine Laboratory at this time consisted of cramped and inadequate quarters at the old salt-water baths in Cullercoats Bay. Using this as a base, Meek carried out many investigations into problems of the local inshore fisheries. In his report for 1904, Meek recorded the destruction by fire of the old wooden laboratory and the complete loss of records, specimens and apparatus. But he also announced the formation of a committee the object of which was to collect funds for the establishment of a new and more adequate laboratory. As the result of the efforts of this committee and especially of Meek himself, a sum of money was collected which was, however, insufficient for the purpose. The situation was saved by Mr. W. H. Hudleston, who erected the present building at his own expense. Armstrong College at first was the tenant, and afterwards purchased the Laboratory which was opened in 1908 as the Dove Marine Laboratory.

Established at last in a well-built and up-to-date marine laboratory with a good aquarium and sufficient working space, Meek launched out into many activities. The long series of annual reports which he edited and to which he contributed so largely show how few aspects of the local inshore fisheries escaped the attention of himself or his staff and students. Meek had the welfare of the fishermen at heart and he had a remarkable power of gaining their confidence. One important result of his work and influence is to be seen to-day in some of the local by-laws governing the crab and lobster fisheries.

Apart from his more strictly economic studies of fisheries, Meek covered a wide field. Much faunistic work, especially in relation to fishes and amphipod Crustacea, was published by him in the Dove Marine Laboratory Reports. His book "The Migrations of Fish", published in 1916, was an important contribution at the time and is still valuable. He was the first to point out the importance of *Sagitta setosa* and *S. elegans* as plankton indicators. He was also interested in embryology, on which subject he published a number of papers.

Meek was a man of strong personality who could inspire enthusiasm and loyalty in his colleagues and students. He succeeded worthily to the great tradition of marine biology on the north-east coast of England, and his greatest achievement was, perhaps, the establishment of a laboratory in which this work still continues.

A. D. HOBSON