he carried out and completed some of his most well-known investigations.

Zsigmondy's early work was concerned with glass and the colours produced by the presence of metals or metallic oxides. This led him to take up the study of colloid chemistry, and in 1898 he published his well-known work on colloidal gold. He successfully prepared gold sols of reproducible properties and showed that they owed their colour to minute particles of metallic gold, which were held in suspension by the electric charge they possessed. He further showed that removing this charge by the addition of electrolytes precipitated the gold and it was impossible to bring the precipitate back into suspension. Zsigmondy very quickly realised that the colour of his gold sols closely resembled that of gold ruby glass, and he turned his attention to this material, with the result that he definitely proved that ruby glass also owed its colour to the presence of very minute crystals of metallic gold.

Another problem which was attracting a great deal of attention at this time was the constitution of Cassius purple. Very many chemists, including Berzelius, believed that this substance was a chemical compound, but the whole question was satisfactorily solved by Zsigmondy when he synthesised the purple from colloidal gold and colloidal stannic acid. Furthermore, his method of determining the relative protective power of hydrophyllic colloids by means of the gold number is familiar to all colloid chemists.

These investigations on colloids proved that for the successful observation of these small colloidal particles more refined apparatus was necessary. Zsigmondy concentrated his energies on the solution of this problem and conceived the idea of the ultramicroscope, which, with the collaboration of Prof. Siedentopf, he brought out in 1904. This new apparatus enabled chemists to observe particles which hitherto had been invisible and it gave a new impetus to the direct study of the Brownian movement.

In 1907, Zsigmondy was called to Göttingen as Director of the Institute for Inorganic Chemistry, which he converted into a school of colloid chemistry where students from all over the world collected to study this branch of chemistry. During the early period of his stay at Göttingen, Zsigmondy turned his attention to the study of gels and gel structure, and he put forward the generally accepted capillary theory for the explanation of vapour pressure curves of silica gels as determined by van Bemmelen. His work during this period gave the study of gel structure a new interest and importance in the minds of chemists.

Later, Zsigmondy became interested in the preparation of collodion membrane filters. With characteristic thoroughness he explored the various ways and means of obtaining reproducible filters of definite and uniform pore size. This was essential if the filters were to be of any use in either colloid chemistry or bacteriology and biology. The final outcome of a period of intensive investigation and experiment was the preparation of the now widely used Zsigmondy membrane filters. These investigations were carried still further with the production of very uniform ultrafilters of varying pore size down to a diameter of about 4 $\mu\mu$. With further work he succeeded in preparing 'cella' filters for use with organic solvents. Zsigmondy was awarded the much-coveted Nobel Prize for chemistry for 1925 in recognition of his important pioneer work in the comparatively new field of colloid chemistry.

Zsigmondy made some excellent contributions to the literature on colloids in general. In 1905 his "Erkenntniss der Kolloide", containing a full account of the development of the ultramicroscope and of his original work, was published. The first edition of his general treatise on colloid chemistry appeared in 1912, and a completely rewritten edition in 1927. Another contribution, in which he collaborated with Dr. Thiessen, is "Kolloides Gold", which is one of the few standard works on the subject.

In February 1929, Zsigmondy was forced by failing health to retire from his duties at the Institute, and in October last he died at his home at Göttingen. To those who had the privilege of working under him, it was felt as a personal loss of an inspiring teacher and a sincere friend, while the whole scientific world must feel that one of its great men has passed away.

Dr. T. Wemyss Fulton.

More than fifty years ago Thomas Wemyss Fulton and I worked side by side in Turner's dissecting-room in Edinburgh, with David Bruce and Noël Paton among our comrades there. D. J. Cunningham, then senior demonstrator, was studying the anatomy of the *Challenger* marsupials; the junior demonstrator was designing the Cathcart microtome; and the laboratory attendant, 'old Stirling', the real first inventor of the microtome, was making his exquisite preparations, as Goodsir had taught him to do. A prize, of some value for those days, was given for the best dissections of the year; I have forgotten its name, but I remember that I won it one year and Fulton the next. Scholarships were few and scanty. Many of us found some employment, to help pay our way—in part or whole; and Fulton, with indomitable strength, courage, and self-denial, was a telegraphist by night in the G.P.O. and a medical student by day. He graduated with first-class honours; and when he took his M.D., three years later, his thesis was a study of 'telegraphists' cramp', based both on observation and experience.

John Murray, a good judge of men, took Fulton as one of his assistants in the task of seeing the *Challenger* Reports through the press. After a couple of years of this useful experience, Prof. Cossar Ewart brought him into the Scottish Fishery Board's service; and there he remained, afterwards becoming the Board's scientific superintendent under the Act of 1895.

Dr. Fulton's own papers began to appear in the

Board's report for 1888, and the output went on steadily for thirty-four years. He made countless observations and not a few discoveries regarding fishes, their early development and subsequent rate of growth, their migrations and distribution, their habits and their food. Some of his best papers were those in which he demonstrated (in 1895 and later) the cyclonic surface-currents of the North Sea, and the influence of this circulation on the distribution of fish-eggs and young fishes.

Beam-trawling began in Scotland just a little while before Fulton came to the Fishery Board; the otter trawl followed about 1895, and at once ousted the beam; and the fishermen complained bitterly of the new industry. At first the Board was little in favour of restrictions; in 1884 it pronounced against a *mare clausum*, adding, however, that "the true principle is freedom, *qualified by such regulations* as in the common interest may be found just and necessary". Dr. Fulton's sympathies were all with the line-fishermen; he wished to protect them, and his influence had a deal to do with shaping the policy which closed the Firths of Forth and Clyde and the great area called the Moray Firth. He convinced himself, more than forty years ago, that there had "already been a gradual and considerable diminution of the average catch of Scotch beam-trawlers, per ton of the vessel's tonnage"; and he said that "it would not be seriously contested that the supply of fish, relative to the machinery of capture, has diminished and is likely to continue to diminish".

Very difficult questions soon arose out of the closure of the Moray Firth, and helped to turn Fulton's attention to the thorny subject of maritime law. In 1911 he published his *magnum opus*, on the "Sovereignty of the Sea". The lawyers have not always, I believe, seen eye to eye with him on matters of opinion or interpretation; but the book, obviously and admittedly, is a mine of historical information and curious learning. The earlier chapters, especially those on our troubles with the Dutch in Charles II.'s time, are delightful reading. D'ARCY W. THOMPSON.

COL. SIR THOMAS HOLDICH, K.C.M.G., K.C.I.E.

SIR THOMAS HUNGERFORD HOLDICH, who died on Nov. 2 at the advanced age of nearly eighty-seven, spent most of his active life in the Survey of India, where he was largely engaged on Frontier and trans-Frontier work. His commission in the Royal Engineers dates so far back as 1862. His first war service was with the Bhutan Expedition in 1865, followed by the Abyssinian campaign in 1867 and the second Afghan War in 1878–80. But his survey career will chiefly be remembered by his work on successive boundary demarcation commissions, and probably he served on more of these than any other office. In 1884 he was with the Russo-Afghan Boundary Commission in connexion with which the once famous, though now almost forgotten, Panjdeh incident took place. As superintendent of frontier surveys he was concerned with the extension of maps on and beyond the Indian frontiers. During this period he was engaged in 1894 on the demarcation of the eastern boundary of Afghanistan, between that country and the frontier tribes. In the following year he was with the Pamir Boundary Commission. Finally, he was appointed chief commissioner for the demarcation of the frontier between Persia and Baluchistan. In 1898 he retired after thirty-six years' service in India.

With such a record it is not surprising that Holdich was appointed, shortly after his retirement, to be a member of the tribunal dealing with the disputed boundary between Argentine and Chile, which had been referred to King Edward as arbitrator. This tribunal, presided over by the late Lord Macnaughton, heard evidence from both sides in London. A stage in the proceedings was reached, however, when it became necessary, through lack of geographical information, that the country in dispute should be inspected. For this purpose Holdich and a party of survey officers visited Chile and the Argentine during the winter of 1901–2. After the additional evidence thus collected had been placed before the tribunal, King Edward gave his award in the autumn of 1902.

In the meantime, the two countries decided that the actual boundary, as awarded, should be marked out on the ground in the presence of a commission appointed by the British Government. Holdich became chief commissioner for this purpose and again visited South America in the winter of 1902–3. The final settlement of this important boundary, which had been the cause of continuous and dangerous friction between Argentine and Chile, was at last completed. This was one of Holdich's most successful achievements. He possessed in an eminent degree the art of conciliating divergent elements, which gave him a great advantage in dealing with questions of this kind. He had the pen of a ready writer and was also a fluent and pleasant speaker. The excursions which he made into the historical and picturesque aspects of trans-frontier exploration were much appreciated. He was also an admirable artist, and brought back many pictures of the various places he visited.

Holdich's inclinations always seemed to tend towards the political, artistic, and literary, rather than to the scientific side of life, which did not really interest him. For his various services he was made at different times K.C.M.G., K.C.I.E., C.B., and C.I.E. He served as president of the Royal Geographical Society from 1916 to 1918, and he was the oldest holder of the Society's gold medal. He was the author of several works, notably "The Indian Borderland", "The Countries of the King's Award", and "The Gates of India". H. L. C.

REV. CAMILLO MELZI D' ERIL.

FATHER CAMILLO MELZI D' ERIL, who died on Mar. 10 last, was born on Jan. 6, 1851, and thus at the time of his death was one of our oldest seismologists. He was educated at the Carlo Alberto College, Moncalieri, and later was admitted to the Barnabite Order. In 1873 he joined the teaching