development of a truly scientific mind. This as a general statement may perhaps be admitted, though it must be at once pointed out that the difference between the intellectuality of a schoolboy aged sixteen and of a medical student aged seventeen *qua* age is not great, if it exists at all, and postponement of the teaching in these subjects beyond seventeen or eighteen would certainly be impossible.

All are agreed that the attainment of scientific methods of observation and reasoning is a quality of the first importance to the future medical man, especially as the ultimate result of his education, viz. the practice of medicine or surgery, is essentially an inexact science, one in which the data for the formulation of conclusions are extraordinarily inconstant and ephemeral, often demanding for their detection the most trained observation, and for their elucidation the most careful reasoning.

The medical curiculum is, however, filled to the bursting, and unless we want the student to emerge from it partially insane, some depletion must take place. It should also be remembered in this connection that intellectual attainments are not the sole requirements of the medical man. Manipulative skill, and, further, physical training, rendering him capable of enduring physical strain, are also practically essential. This and the fact that the actual subject-matter of medicine and surgery has increased enormously during the last few years, not merely in the direction of biology, chemistry and physics, but also in that of the actual accumulation of clinical fact, render the intellectual burden to be laid, according to the present arrangements, upon the medical student more than he can bear.

Further, the student of medicine stands in a peculiar position with regard to chemistry, biology and physics, for while it is not to be denied that a clear understanding of them is necessary to his education, yet nevertheless it is not only from them that he receives training in the methods of pure science. After having mastered the essential principles of these he still spends two years or more in the study of science, preparatory to entering upon the subject-matter proper of his profession. The first, second, and often third year are devoted to physiology, anatomy and pharmacology ; all subjects which tend, not only to store the mind with fact, but also to educate it in scientific method. If the training of the medical student in scientific method depended solely upon the teaching in chemistry, physics and biology, referred to in the memorial we have received, we confess that we should view with concern the relegation of these subjects to the schools ; clearly, however, this is not the case, and since something must be done to relieve the overwhelming mass of knowledge to be acquired by the average student in five short years, we feel that the General Medical Council are acting wisely in demanding more of the schools. It is, however, to be hoped that it will see that the school teaching in these subjects is efficient and that the student comes up to the medical school thoroughly grounded in them.

F. W. T.

SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY.

THE publication of the Summary of Progress of our British Geological Survey for the year 1900 has evidently been delayed, for we have long ago received and noticed the annual reports of the Canadian and Indian Geological Surveys, and we have likewise referred to the retirement of Sir Archibald Geikie, who in this publication issues his last official report on the work which for so many years he directed. It is a report which, as usual, provides material of sufficient diversity to interest students of all branches of geology. Those who cultivate a knowledge of the oldest rocks will find ample material for consideration in the accounts of the Moine schists and Muscovite-biotite gneiss of Ross-shire, and in the fuller descriptions of the Dalradian or younger schists of the central Scottish Highlands. Thrust-planes and the phenomena of thermo-metamorphism and contact-metamorphism are dealt with, as well as the relations of the schists to the older and newer granites and other igneous rocks. Outside the great granite masses of Lochnagar and the Cairngorm Mountains there is an exceptional extension of cordierite-hornfels, due to the alteration of aluminous black schist ; while impure limestones are characterised by the development of silicates, of garnet, idocrase, malacolite and wollastonite. Special attention is drawn to the distinction which it is sought to make between the band of schists known to the surveyors as the "Green beds," originally sedimentary rocks, and the Epidiorites, which occur as sills of much-foliated igneous rock. The "Boulder bed" also forms an important horizon in the mass of Dalradian schists. In some places it affords evidence of having been in part a true conglomerate before any movement such as shearing or crushing took place ; elsewhere it appears as a crush conglomerate, or it presents an "augen-structure" on a gigantic scale. In Ireland attention was mainly given to the Silurian rocks of Waterford and Wexford and their associated intrusive and volcanic rocks, which are described in some detail. In the south-west of England work was carried on among the Lower Devonian rocks of Looe in Cornwall and on the various subdivisions of the "Killas" near Falmouth, the "greenstones," and the granite of Penryn.

In the great South Wales coal-field work has been vigorously prosecuted in the district around Swansea. There the Old Red Sandstone and the Lower Carboniferous rocks are of especial interest in connection with their Devonshire equivalents, and it is of the highest interest to learn that radiolarian chert has been recognised in the Gower series described long ago by De la Beche and compared by him with the Coddon Hill beds of North Devon.

The Gower series occurs on top of the main mass of Carboniferous Limestone and belongs to the group of "Upper Limestone shales." These are represented on the north crop of the South Wales coal-basin by "Rottenstone shales," in which also bands of radiolarian chert have been discovered. The upper part of the Gower series consists of a mass of dark shales in which *Goniatites* (*Glyphioceras*) *bilinguis* and *Posidonomya* have been found. At a higher horizon come the hard sandstones and conglomerates of the Millstone Grit. The discovery of these radiolarian cherts is thus an important link in the correlation of the strata in Devonshire and South Wales, for it had been held that the Coddon Hill chert beds might represent the mass of the Carboniferous Limestone. As the work of the Survey proceeds westward further interesting results may be anticipated, especially with regard to comparisons between some of the underlying Lower Carboniferous strata and the Upper Devonian. The Old Red Sandstone has been studied as far north as Caithness, where some of the flags and shales are so bituminous as to become impure oil-shales, while albertite or mineral pitch is found distilled out into the faults and cracks of the strata over large areas. In Argyllshire the relation has been worked out between some of the younger granites of Ben Cruachan, Blackmount and the Moor of Rannoch, and the vents of the Lorne volcanic region. As these vents belong to the time of the Lower Old Red Sandstone, the granites which invade them probably belong to the remarkable series of granite extrusions which in the British Islands intervened between the close of the Upper Silurian and the beginning of the Upper Old Red Sandstone periods.

Details are given of the various coal-seams and of

faults and disturbances observed in the coal-field near Swansea ; and important suggestions are made regarding the subdivisions recognised in the Upper Coal-measures of North Staffordshire and their extent westwards across the Cheshire plain, and south-westwards into the Birmingham area.

The discovery of Rhætic, Liassic and Cretaceous fossils in rocks, preserved within an old volcanic vent in the Isle of Arran, is of especial interest as indicating the former extent of these Secondary strata. The Cretaceous rocks of the south of England have received attention, more especially as regards the Lower Greensand of parts of Sussex and the Isle of Wight, the subdivisions in which are compared.

Students of Tertiary strata will find interesting references to the successive overlaps of the London Clay and Bagshot beds on the western side of the Hampshire Basin. The volcanic series of Arran and of Skye come into notice also in the portions of the Summary which deal with Tertiary times.

In various parts of the country observations have been made on Pleistocene deposits, the most important being the full account of the glacial phenomena in the Macclesfield district.

The petrographical work includes a particular account of the marbles of Assynt, which have resulted from contact metamorphism produced by igneous rocks on surrounding dolomites. The palæontological work includes important catalogues of type-specimens of Pleistocene, Pliocene and Devonian fossils preserved in the Museum of Practical Geology ; and there are special notes on Carboniferous plants from Berwickshire and on the fossil fishes from the Silurian rocks of the Lesmahagow district. In this brief abstract of some of the results of a year's work on the Geological Survey we have refrained from mentioning individuals, but the work of each has been carefully indicated in the memoir. It is satisfactory, moreover, to note the assistance that has been rendered by Mr. R. Kidston, Dr. R. H. Traquair and Dr. G. J. Hinde in the identification of particular groups of organic remains.

SIR J. HENRY GILBERT, LL.D., F.R.S.

THE names of Lawes and Gilbert have been "household words" in the mouths of English students of agriculture during the past half century. Sir John Lawes departed from amongst us last year, at the age of eighty-five. His colleague, Sir J. H. Gilbert, has also now finished his labours ; he died at Harpenden on December 23, at the age of eighty-four.

Joseph Henry Gilbert was the second son of the Rev. Joseph Gilbert, a nonconformist minister at Hull. He was born at Hull in 1817. His mother, Ann Gilbert, was a daughter of the Rev. Isaac Taylor, of Ongar, and thus belonged to a well-known literary family ; she was herself the authoress of numerous poems for children. While at school young Gilbert met with a serious accident, and practically lost the sight of one eye. His great pluck enabled him to accomplish his life's work with little apparent hindrance, but the disadvantage of weak sight was very real, and much of his subsequent literary work had to be dictated. He went from school to Glasgow University and studied chemistry under Dr. Thomas Thomson. From thence he went to University College, London, and commenced working in the laboratory of Dr. Antony Todd Thomson. Here apparently he first made the acquaintance of Mr. John Lawes, who was a frequent visitor to the laboratory. He next proceeded to Giessen, where Liebig was then professor of chemistry, and took the degree of Ph.D. in 1840. Dr. Gilbert then acted for a short time as assistant to Dr. Antony Todd Thomson, and afterwards left to take up calico printing and dyeing in the neighbourhood of Manchester.

It was in 1843 that Dr. Gilbert's services were engaged by Mr. Lawes for the agricultural investigations then commencing at Rothamsted. We have already noted in these pages (NATURE, September 13, 1900, p. 467) the foundation of the Rothamsted agricultural investigations by Mr. J. B. Lawes, their rapid development at his sole expense, and their subsequent liberal endowment by him ; we have now to mention the important part taken in the work by his collaborator, Dr. Gilbert.

The two investigators were, to a considerable extent, well matched, each supplying some deficiency in the other. Sir John Lawes brought to the work a very original mind, an enterprising spirit, and a thorough knowledge of the facts of practical agriculture ; and this practical knowledge served to inform his judgment and enabled him to test the truth of many of the scientific theories which came before him. Sir J. H. Gilbert, on whom the details of the work devolved, brought to his task a more exact knowledge of science and of methods of investigation, an acquaintance with foreign chemists and foreign literature, and, above all, methodical habits of work, which proved of immense value in planning and carrying on through fifty-eight years the field experiments which became such a striking feature in the Rothamsted investigations. He was an indefatigable worker, and loved to accumulate an immense mass of results, frequently of a similar kind ; and a reader of Rothamsted papers is sometimes so overwhelmed by numerical statements that, to use a familiar simile, "he finds it difficult to see the wood for the trees."

The Rothamsted investigators soon found themselves engaged in controversy with German men of science, and Sir J. H. Gilbert at once proved himself to be a warm and untiring antagonist. The first subject of dispute was the so-called "mineral theory" of Baron Liebig. Liebig held that the atmosphere supplied in sufficient quantity both the carbon and nitrogen required by crops, and that the proper function of manure was to supply the ash constituents of the crop it was intended to grow. On the other hand, the Rothamsted field experiments with wheat and barley proved unmistakably that ammonium salts and other nitrogenous manures had a far greater effect in increasing the produce than any application of phosphates, potassium salts, or other ash constituents. So long as the question was confined to the cereal crops, Rothamsted was triumphant ; but when leguminous crops became the subject of experiment the answer was doubtful, and in many cases the manures supplying ash constituents proved the most effective. It has taken many years, and tasked many investigators, to elucidate this part of the subject. We now know that the roots of leguminous plants become the habitation of certain bacteria, and that by means of these the plants are fed in a special manner with nitrogen from the atmosphere.

The subject of the assimilation of nitrogen by plants led to one of the most highly prized of the Rothamsted investigations, in which plants were grown from seed in soils destitute of nitrogen, but supplied with ash constituents, and in an atmosphere free from ammonia, the object being to ascertain in a rigorous manner if an assimilation of the free nitrogen of the air took place. The work lasted three years, and was made the subject of a communication to the Royal Society by Lawes, Gilbert and Pugh. The chief honour of the work belongs, in this case, to the last-named author. Pugh was an American studying in Germany, and when the controversy on nitrogen assimilation between Boussingault and Ville was at its height he offered to come to Rothamsted and help to solve the question. His offer was accepted. The whole of the experimental work was conducted by Pugh with an ingenuity and accuracy which were justly admired.