Department's grants in that year was 158,370. These students were distributed among 11,723 classes in 2023 different schools. Scotch schools and students are not included in these figures, the Scotch Education Department having taken over the administration of grants for science and art instruction. Even more satisfactory than the increase of the number of pupils receiving science instruction is the fact that in 1898 there were 159 Schools of Science—that is, schools following an organised course of scientific instruction—in which practical work forms an essential part. The number of students in these schools was 21,193. This is a considerable increase on the preceding year, when the number of Schools of Science was 143, with 18,142 students.

For the year 1898 the grants to science schools in England, Wales and Ireland, exclusive of those made to training colleges, amounted to 169,604*l.* 3*s.* 3*d.* The sum included (*a*) 85,862*l.* to science schools for attendance grants, and 614*l.* on results of examination (honours only); total, 86,476*l.*; (*b*) 82,998*l.* to Schools of Science, for capitation and attendance grants and grants on results of examination.

The figures under (*a*) show an average payment in 1898 of 12*s.* 7¼*d.* for each individual student under instruction in science schools, whilst the average payment per student under instruction in Schools of Science (*b*) was 3*l.* 18*s.* 2*d.*

The grants now made to schools are based upon the attendance of pupils, instead of being computed on the results of the individual examinations. Referring to this change and to the increase of practical work, Captain Abney, the Director for Science, says:—"In the past year, the system of payments by attendance was made general to all schools except in the case of Schools of Science. From this mode of payment candidates for honours were necessarily omitted, their work being necessarily special and requiring special treatment. The abolition of payments on results has diminished to some extent the numbers of students who were presented for examination, and the course of instruction in the various stages of the subjects of science for which payments are made will be more prolonged. This undoubtedly tends to sound instruction. . . . There is a decided increase in practical instruction in various subjects, and in many places laboratories for physics and for biological subjects have been provided, as the higher attendance grant is only attainable where such provision has been made. I cannot help commenting upon the very marked impression that the obligation to give practical instruction in science has made in the elaboration of apparatus for teaching purposes. At a conference on science teaching, held at the Chelsea Polytechnic under the auspices of the London Technical Education Board, there was an exhibition and demonstration of the use of science apparatus in teaching. The novelties in apparatus and the general interest taken in the conference by science teachers and others clearly indicated the rapid advances that had been made in this branch of teaching"

The Reports of the Inspectors of the Department include many points worthy of the consideration of educationists. The following extracts contain a few of the views expressed on the general subjects of secondary schools and science teaching; and as they represent opinions based upon direct experience of the conditions of elementary scientific instruction in this country, they have exceptional value.

Extracts from Reports.

Many of the smaller secondary schools are still badly equipped for teaching purposes. Most of them are ill-supplied with funds, and have consequently an inadequate and inferior staff of teachers, while some few are bent upon continuing methods and subjects of instruction which must be of little value to the class from which their pupils should be drawn. It is, moreover, impossible to deny that owing to the practical absence of outside criticism some few secondary schools are hopelessly inefficient. . . . Many country grammar schools have reason to be thankful to the County Councils for the very liberal aid they have received towards the erection or equipment of suitable rooms for science purposes, or towards the payment of a science master. The County Councils can for their part in most cases ensure that the science work is thoroughly and systematically given by requiring the school to place itself in connection with the Department. To this the best and most progressive of the smaller schools offer no objection. They realise that assistance from public funds must be accompanied by some amount of public control, and as a rule the visit of the inspector is most feared where it is most unknown. Still, in spite of County Council assistance and Department grants, many of the endowed grammar schools are still in straitened circumstances. Where fees are low and endowments small, it is often a serious matter to secure a proper staff of teachers, to keep fittings and apparatus in a proper state of completeness, and to provide for the necessary outlay on repairs, rates and taxes. It is therefore not a matter for surprise if the science and art appliances in some of the secondary schools are found to be meagre in quantity and poor in quality.

On the whole, it may be said that a very fair provision has been made for scientific and technical instruction of the youth of the country up to, at any rate, the age of sixteen or seventeen, supposing them to devote themselves to study until attaining that age, and that in most large towns the artisan and manufacturer can obtain good instruction in technology and general science. But our larger polytechnics could be much further utilised if research work in their laboratories were more encouraged.

It would be most helpful to the technical education of the country if a fairly liberal grant could be paid on any student who, having acquired sufficient training in science, devoted himself to some special work in a laboratory under the supervision of the teacher in charge. The results of such work might be examined and criticised by the professors and examiners of the Department, and, if worthy, brought to the notice of the various societies for the promotion of scientific investigation.

The freedom from examination in the elementary courses of Schools of Science has had considerable influence on the character of the teaching, especially in the practical work. Teachers have awakened to the fact that science may afford a sound mental training, and that method is no less important to a student than results. Syllabuses exhibit a more logical sequence. Instead of depending upon a course thought out by others, teachers are beginning to think out their own, and although there is room for improvement, enlightened methods are making way. The "Heuristic method," which seeks to make each boy or girl a "discoverer" of known physical laws, and thus develop in him the scientific spirit, has had an important influence on the teaching of science. In the hands of a highly competent teacher it is an important guiding principle—in the hands of some of its disciples there is danger of its becoming a fetish. The Heuristic method is essentially historical; the pupil is told little, but is put in the way of finding out for himself, which is well. But there is as much danger in telling him too little as in telling him too much. It is not perhaps impertinent to point out that scientific discoveries have seldom been inductive. Investigators have been acquainted with the results of other discoverers, and have had, almost invariably, a "working hypothesis" which they have sought to establish by deductive methods. It is therefore advisable to lay stress on the usefulness in teaching science of a "working hypothesis," which should form the basis of practical work having for its object the "discovery" of a law. Though the beginner "must be put in the position of an original discoverer," it should be borne in mind that an original discoverer has at his disposal the observations and views of other investigators. It is only fair that the student should be placed in pretty much the same position, otherwise his observations will be ill-directed, and will lead him nowhere. It is almost needless to remark that in any case the advanced work may be more didactic.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE natural history collections in the Whitechapel Public Library and Museum are being systematically used by many teachers in the elementary schools of the district to illustrate object lessons. Teachers who propose to utilise the collections for this purpose send to the curator, Miss Kate M. Hall, a list of the object lessons they are giving, and arrangements are then made for one or more practical demonstrations bearing upon the lessons. The children (about forty-five in number) are brought up to the museum every week, for 1 to 1½ hours, until the course is finished. They are divided into three groups of fifteen, and each group spends about twenty minutes at each table on which the specimens chosen for the lesson have been placed. In this way the children have the opportunity of closely observing the objects, and of comparing the structure

with that of other animals or plants. By this means the Library Commissioners are making the collection of real service in elementary education.

THE Scottish Education Department has formulated a scheme whereby an agricultural college is to be instituted, to take over the functions of the agricultural department of the Glasgow and West of Scotland Technical College and the Kilmarnock Dairy School. The special grant of 2000*l.* voted for agricultural education in Scotland, and now administered by the Scotch Education Department, has been distributed in various amounts to four institutions, two being those mentioned and the two others the Edinburgh School of Rural Economy and the Agricultural Department of Aberdeen University. It has, however, long been felt that the grants to these institutions ought to be reinforced by contributions from local authorities in order to place the institutions in a position to exercise a more decided influence upon the progress of agriculture in Scotland than has yet been possible. Several County Councils having recently promised support, in some cases of a very substantial kind, to an independent agricultural college in the West of Scotland, the Scotch Education Department prepared a scheme for such an institution, and it has been accepted by the various bodies concerned. The college will give facilities for the most thorough and highly developed instruction in agriculture to those students who are able to devote a considerable time to this study, and should at the same time be a means of bringing home to the agricultural population of the districts concerned the latest results of agricultural research.

THE degree of Doctor of Philosophy was conferred in 1898 upon 224 candidates by twenty-three universities in the United States. An analysis of the statistics referring to these doctorates is given in *Science*, together with the names of those who received the degree in science, and the titles of their theses. Of the 224 degrees, 72 were in the humanities (under which are included philology, grammar, literature and philosophy), 37 were in history and economics, and 115 in the sciences. Six universities, Johns Hopkins, Columbia, Yale, Chicago, Harvard and Pennsylvania, conferred 169 degrees—more than three times as many as all the other United States universities combined. Columbia gave this year decidedly the largest number of degrees in the sciences, while Harvard is the only one of these universities in which the degrees in the humanities were more numerous than in the sciences. The distribution of students among the different sciences was as follows:—Chemistry, 32; psychology, 15; mathematics, 13; botany, 11; zoology, 11; physics, 7; education, 5; geology, 5; sociology, 5; palæontology, 4; astronomy, 2; mineralogy, 2; physiology, 1; bacteriology, 1; meteorology, 1. It will be noticed that chemistry leads very decidedly. While no definite conclusion can be drawn from the results, it may be noted that at Johns Hopkins more than half the scientific degrees are given in chemistry. This science also leads at Yale and Harvard. Psychology and education are especially strong at Columbia. Chicago stands first in zoology and in physiology.

THE Technical Instruction Committee of the Oxfordshire County Council have presented their annual report on the work of the schools and institutions aided by them during the past year. The Committee has been recognised by the Department of Science and Art as the organisation responsible for science and art instruction within its area. No grants will therefore be made by the Department to the managers of new schools and classes unless they are acting in unison with the Committee. The managers of all the schools and classes in the county which are receiving Science and Art grants have agreed to come within the new organisation. With regard to rural agricultural instruction, the Committee report that at the Chipping Norton Agriculture Class, under Mr. W. Warne, there were seventy-six students, of an average age of 39·5. They were factory hands, labourers, mechanics and small tradesmen, who all cultivated allotments. One thousand and twenty attendances were made at twenty-four meetings. The subject of the course was "Insects as friends and foes to agriculture." To illustrate how agriculture is being gradually developed by the work of the science lecturers, the Committee report that from advice given by Mr. Stewart, at Minster Lovell, in his lectures, an acre of strawberries was planted. This year a much larger area was laid down there. It is hoped that an industry in soft fruit is now started in that locality. At the same place a fruit farm of three acres was laid out two years ago on Mr. Stewart's advice. It was so successful that now twelve acres are laid out. At Stoke Row, eight tons of filberts last year were saved by the treatment given to the nut weevil, and last year the currant bushes were afflicted by the currant mite, but spraying the bushes enabled four tons to be marketed. Codlin moth and apple-blossom weevil attacked the apple trees, but Mr. Stewart's treatment saved the trees. When agriculturists are brought in this way to see the practical side of scientific knowledge they begin to understand the value of the science of agriculture.

SCIENTIFIC SERIALS.

American Journal of Science, July.—Velocity of electric waves in air, by G. V. Maclean. The author describes an elementary type of coherer suitable for the Hertzian experiment of determining wave-lengths from nodes produced by metallic reflection. It consists of two globules of platinum, 1 mm. in diameter, attached to the ends of two platinum wires forming spirals about two iron terminals which run through the centre of the two brass caps of a glass tube 8·5 cm. long. The globules can be adjusted to any small distance from each other. The velocity of propagation, determined from the wave-length and the period of oscillation, is $2{\cdot}991 \times 10^{10}$ cm. per second, or practically the same as along wires.—Spiral fulgurite from Wisconsin, by W. H. Hobbs. A lightning tube forming a perfect dextrorotary helix has recently been presented to the geological collection of the University of Wisconsin. It was found embedded in a sand knoll about ten feet high, at a distance of five feet below the surface. The tube is as thick as a man's thumb, and five inches long. The fulgurite from Waterville, Maine, described by Bayley in 1892, also shows a dextrorotary structure. The author suggests that this twist is somehow connected with the electrical conditions under which the tubes were produced, and guesses at an influence of the earth's magnetic field upon the path of the lightning.—The mouth of Grand River, by E. H. Mudge. The mouth dealt with is not the present Grand Haven, but another point seventy miles inland from the shores of Lake Michigan, which was the termination of the old river valley. At one time a great glacial stream, three-fourths of a mile in width, flowed across the peninsula from Lake Saginaw to Lake Chicago. This stream has been called the Pewamo outlet. The author describes its course and the river-mouth deposits about the old mouth.—Electrical measurements, by H. A. Rowland and T. D. Penniman. The authors have tested six out of the thirty different methods of measuring self-induction and capacity indicated by Rowland. The methods for the comparison of the two self-inductions, or a self-induction and a capacity, are independent of the period of the alternating current used, and an accuracy of 1 in 10,000 can be attained.—Reflection of Hertzian waves at the ends of parallel wires, by L. de Forest. The author uses a compromise between the Lecher and the Blondlot wire systems, and investigates the relation between the change of phase in reflection from bare ends of various shapes, and the frequency.

Wiedemann's Annalen der Physik und Chemie, No. 6.—Observation of fringes in the development of Daguerre plates with wedge-shaped silver iodide layers, by O. Wiener. A silver plate was iodised in two wedge-shaped layers by laying it on a glass tube during exposure to the iodine vapour, the layer thus being made to increase in thickness from the line of contact outwards. A spectrum with the slit normal to the lines of equal thickness was then photographed on the plate, and it was found that the sensitiveness varied periodically with the thickness, maxima occurring whenever the surface coincided with a ventral segment of the electrical force, produced by reflection at the boundary dividing the iodide from the metallic silver.—Experiments on certain flow formations, by K. Mack. Deals with the deformations of fungoid flow structures by gravitation, and the deformation of horizontal layers of liquid by ascending fungoid structures.—Influence of gaseous pressure upon electric currents due to Röntgen rays, by W. Hillers. Near the pressure at which the gaseous resistance reaches a maximum, the current intensity varies as the square root of the pressure.—An electrolytic current interrupter, by A. Wehnelt. This is a reprint of the author's original paper from the *Elektrotechnische Zeitschrift*.—Action of the Wehnelt interrupter, by H. T. Simon. The author formulates what he claims to be a complete mathematical