AN IMPROVED METHOD OF OPERATING THE SPRENGEL AIR-PUMP.*

By Professor Ogden N. Rood.

Professor Rood's paper gave an account of his experiments with the pump for the purpose of obtaining the highest possible vacua. He first experimented with an arrangement similar to the ordinary form of the Sprengel pump, and reduced the pressure to one three-millionth. The exhaustion went on very rapidly at first and then very slowly—slower than the increased rarefaction seemed to call for. This indicated a leakage, and it was found that this leakage amounted in one minute to one-eighty-seven millionth of an atmosphere. The form of the pump was modified to correct the leakage, and a vacuum was obtained with a pressure of one-sixty-millionth. It was impossible to get beyond that point, and it occurred to Professor Rood that the potash he used might have given out moisture. He therefore substituted sodium, and the pressure rose only to one-four-millionth. Anhydrous phosphoric acid was substituted for the sodium, and the pressure fell to one-millionth. It finally struck the experimenter that the trouble was in the gauge, and when a correction was applied to the gauge, vacua were obtained with pressures of one ninety-four-millionth and one-hundred-and-ten-millionth. Higher vacua even can be obtained.

It had recently been stated in *Nature*, said Professor Rood, that his arrangement was exhibited four years ago at the Kensington Garden, and he would not, therefore, call it new. But the best result obtained in England was one-twenty-millionth, and the best result reached by an eminent French chemist was one-seventeen-millionth. He, therefore, thought there must be at least something new in his method of using the Sprengel air-pump.

REPORT OF THE COMMISSIONER OF EDUCATION, FOR 1878.

(*Extracts.*)

TEXT-BOOKS AND COURSES OF STUDY.

The lack of uniformity in the conditions of public education in the different States is illustrated in the report on text-books and courses of study.

Returns from 31 States present the following information:

The State board is empowered to decide these matters in California, Connecticut, Delaware, Louisiana, Nevada, and Oregon. In Kansas, Nebraska, New York, and Rhode Island, the State superintendent or commissioner has authority to recommend the text-books to be used, but their adoption and the course of study are finally decided by the school committee or district boards. In Iowa and South Carolina these matters have been decided by a commission appointed for the purpose. In Maine, authority in these matters is delegated to the town supervisor or school committee; in Maryland, to the county commissioners; in Massachusetts, to the school committee; in New Jersey, to school trustees of districts acting with the county superintendents; and in Pennsylvania, to the directors and controllers of each school district, acting with the teachers. District or local boards either solely or acting in concert with superintendents and teachers decide these matters in Michigan, Mississippi, Missouri, Ohio, and Wisconsin.

In the following States—Minnesota, New Hampshire, Tennessee, Texas, Virginia, and West Virginia—the course of study is prescribed by law, but in the application discretion is given to superintendents, local boards, teachers, &c.

In Indiana, North Carolina, and Vermont no definite provision with reference to these matters has been made.

UNIVERSITIES AND COLLEGES.

The total number of universities and colleges reported is 358, with 3,885 instructors and 57,987 pupils. In the preparatory departments of these institutions were 682 instructors and 26,266 students; in the collegiate departments, 3,203 instructors and 30,368 students: unclassified, 1,353. They had 2,187,932 volumes in their libraries, and the value of their buildings, grounds, and apparatus was $36,871,213; their productive funds, $37,071,958; income from these funds, $2,548,324; receipts from tuition, $1,555,484; receipts from State appropriations, $622,577; aggregate amount of scholarship funds, $1,719,426.

Of the students in the preparatory departments, 18,481 are males and 6779 females; 6,576 are preparing for a classical course and 5,621 for a scientific course. In the collegiate departments, 15,803 (14,152 males and 1,651 females) are in classical course, and 3,893 (2,724 males and 1,169 females) are in scientific course.

The summary of college entrance examinations gives the following facts: Total number of candidates, 5,297; admitted without conditions, 2,553; conditioned in Latin, 822; in Greek, 577; in mathematics, 1,068; in history and geography, 585; rejected for deficiency in Latin, 84; in Greek, 70; in mathematics, 66; in history and geography, 22; in two or more subjects of examination, 424.

There are also statements of the numbers preparing for college, classical, and scientific courses, as follows: number preparing for classical course in academies, 6,206; in preparatory schools, 4,195; in universities and colleges, 6,576; preparing for scientific course: in academies, 2,167; in preparatory schools, 1,107; in universities and colleges, 5,621; in preparatory departments of scientific schools, 1,550; total, 27,422.

Students in institutions for superior instruction are distributed thus, viz.: in colleges, 30,368; in schools of science, 11,603; in schools for the superior instruction of women, 18,115; in all 60,086.

The Commissioner presents a brief outline of the movement in colleges to satisfy the demand that the study of science and sociology be advanced to an equality with the classics and mathematics. Without sacrificing anything of the former curriculum, temporary provision for the new studies has been made in most instances by a system of electives. The action is traced through the record of Harvard and Yale Colleges, and the views of Dr. McCosh, president of Princeton College, Dr. Peabody, of Harvard University, and Prof. B. L. Gildersleeve, of Johns Hopkins University, with reference to the most important conditions of the change, are cited.

Some have feared that in this readjustment of college courses the classics would be sacrificed, but the present tendency is toward greater thoroughness and a more extended range in classical studies; nor under the elective system is the number of students who take the modern in place of the classical course sufficiently large to create any apprehension as to the future influence of classical study.

The prevalent views on this subject are well represented in letters from Professor Hæckel of Jena and Professor Zarncke of Leipzig, which are given in full in the report.

SCHOOLS OF SCIENCE.

Of this class 76 schools, including the United States Naval and Military Academies, were reported to the Bureau. They numbered 809 instructors and 13,153 students. The comparative table for the years from 1870 to 1878, inclusive, shows this to be an increase in all particulars over the figures reported for any previous year. The increase above 1877 was in number of schools, 2; instructors, 28; students, 4,594. The number of students in preparatory departments was 1,436, viz.: 1,153 males and 283 females; the number in scientific departments was in regular course, 4,806; in partial course, 772; number of graduate students, 97. The number of volumes in general libraries was 119,164, an increase in the last school year of 3,543; the number in society libraries was 7,737. The value of grounds, buildings, and apparatus reported, was $7,587,421; productive funds, $5,020,446; income from the same, $319,503; receipts from tuition fees, $68,660; from State appropriations, $484,742.

With reference to schools of science the Commissioner observes:

"By the act of 1862 donating public lands to the several States and Territories which should provide colleges for the benefit of agriculture and the mechanic arts, the movement

* Read before the National Academy of Sciences, N. Y., 1880.

toward scientific training became national, the prospective institutions were sufficiently endowed for the initiatory stages, and each was free to suit its organization to the wants of its locality; the scientific schools previously established had been organized and developed in accordance with strict scientific principles, and their example afforded a powerful opposition to the influences which tended to hold the new schools to a lifeless routine of mechanical exercises on the one hand or to a feeble modification of the methods of classical colleges on the other. The reports of the year indicate that the future of these institutions as schools of applied science, conducted according to the laws of intellectual progress and directed 'to the liberal and practical education of the industrial classes' is assured, and that in the main the character of each school is to be determined by the material condition of the section in which it is placed. Thus, in the East, the tendency is to the training of engineers and scientific experts; in the great agricultural section of the West and South, agriculture and horticulture receive most attention; while in the mineral region of the Pacific section mining and metallurgy are made prominent; but even where these special tendencies are marked, other branches of scientific and industrial instruction have received attention proportionate to the demand."

Interesting facts are presented illustrating the practical advantage of these institutions to our industrial progress. The Commissioner adds that there has been marked advance in the general organization of these schools and in their preparation for efficient work in science and mechanics.

SCHOOLS OF MEDICINE.

The number of schools of medicine, dentistry, and pharmacy reported to the Bureau during the year was 106. These had 1,337 instructors and 11,830 students. The regular school of medicine and surgery reported 64 institutions, 915 instructors, 8,279 students, 2,506 graduates, 46,065 volumes in libraries, $1,685,250 in grounds, buildings, and apparatus, $214,347 of productive funds, yielding an income of $13,186, and tuition receipts to the amount of $289,398. The eclectics reported 6 institutions, 51 instructors, 448 students, 211 graduates, 3,000 volumes in libraries, $161,000 in grounds, buildings, and apparatus, and $8,960 receipts from tuition. The homœopathists reported 11 schools, 158 instructors, 1,215 students, 363 graduates, 39,800 volumes in libraries, $349,000 in grounds, buildings, and apparatus, and $95,471 receipts from tuition fees.

The dental schools report as follows: number, 12; instructors, 161; students, 701; graduates, 218; volumes in libraries, 505; value of grounds, buildings, and apparatus, $68,000; receipts from tuition fees, $60,734.

The pharmaceutical schools number 13; instructors, 52; students, 1,187; graduates, 380; volumes in libraries, 5,175; value of grounds, buildings and apparatus, $155,000; receipts from tuition fees, $25,487.

COLLEGIATE AND PROFESSIONAL DEGREES.

"This Office," says the Commissioner, "is informed that the better colleges and universities of the country are becoming increasingly careful in the bestowal of honorary degrees. At the same time it is well known that the sale of diplomas by persons who have obtained control of collegiate and university charters by purchase or fraud is still going on. This disgraceful proceeding has already injured the reputation of American learning and the value of American degrees in other countries; but the Federal Government did not create the corporations which are causing this scandal and has no power to cancel their charters. It is for the authorities of the State to move in the matter and thus vindicate the honor of the nation and of American scholars."

The following summary of degrees in course and honorary conferred by reputable institutions of learning needs no further explanation:

The number of degrees of all classes conferred was, in course, 9,999, honorary, 396, divided as follows: letters, in course, 3,631, honorary, 114; science, in course, 990, honorary, 6; philosophy, in course, 222, honorary, 31; art, in course, 46; theology, in course, 222, honorary, 159; medicine, in course, 3,814, honorary, 4; law, in course, 1,000, honorary, 78. Of these degrees, classical and scientific colleges conferred 6,367 in course and 388 honorary; colleges for women, 674 in course and 1 honorary; professional schools, 2,958 in course and 7 honorary.

EDUCATIONAL BENEFACTIONS.

The total amount of educational benefactions is $3,103,289, which is distributed as follows: universities, and colleges, $1,389,633; schools of science, $49,280; schools of theology, $397,852; schools of law, $100,000; schools of medicine, $18,562; institutions for the superior instruction of women, $241,820; preparatory schools, $97,191; institutions for secondary instruction, $759,817; institutions for the deaf and dumb, $49,134.

EDUCATIONAL BENEFACTIONS.

During the year 1878 the sum of $3,103,298 was presented to various educational establishments in the United States by private individuals.

Of this sum $1,389,633 were placed at the disposal of universities and colleges. We regret to find that while Theology received nearly $400,000, but $49,280 were devoted to Science, and $18,562 to Medicine. Schools of Law received $100,000. The deaf and dumb received about the same amount as Science.

The University of California received $125,000, $25,000 to build a library building, and $50,000 to purchase books. This amount did not include a collection of works of art and a library valued at $50,000.

Yale College received $189,590. Boston University $30,000 towards the purchase of the Shepard Collection of minerals. From various sources Harvard University received $177,207; Dartmouth College, $35,000: Cornell University, $27,663; Union College, N. Y., $84,000; Oberlin College, O., $25,000; University of Virginia, $50,000 to endow School of Geology and Natural History; Wellesley College, $155,000; Thayer Academy, Mass., $417,000; Deerfield Academy, Mass., $88,000; Dean Academy, $38,000.

PALÆONTOLOGY.

THE DEVONIAN INSECTS OF NEW BRUNSWICK.

In a memoir, on the Insects in the Devonian of New Brunswick, Mr. S. H. Scudder draws the following conclusions in regard to the earliest known insects:

"It only remains to sum up the results of this re-examination of the Devonian Insects, and especially to discuss their relation to later or now existing types. This may best be done by a separate consideration of the following points:

"There is nothing in the structure of these earliest known insects to interfere with a former conclusion that the general type of wing structure has remained unaltered from the earliest times. Three of these six insects (Gerephemera, Homothetus, Xenoneura) have been shown to possess a very peculiar neuration, dissimilar from both Carboniferous and modern types. As will also be shown under the tenth head, the dissimilarity of structure of all the Devonian Insects is much greater than would be anticipated; yet all the features of neuration can be brought into perfect harmony with the system laid down by Heer.

"The earliest insects were Hexapods, and as far as the record goes, preceded in time both Arachnids and Myriapods.

"They were all lower Heterometabola.

"They are all allied or belong to the Neuroptera, using the word in its widest sense.

"Nearly all are synthetic types of comparatively narrow range.

"Nearly all bear marks of affinity to the Carboniferous Palæodictyoptera, either in the reticulated surface of the wing, its longitudinal neuration, or both.

"On the other hand they are often of more and not less complicated structure than most Palæodictyoptera.

"With the exception of the general statement under the fifth head they bear little special relation to Carboniferous forms, having a distinct facies of their own.

"The Devonian Insects were of great size, had membran