Corporation Professor George H. Brush resigned the Directorship of the Sheffield Scientific School, which he has held for twenty-six years, and Dr. R. H. Chittenden, professor of physiological chemistry, was elected Director.

WE understand, though the complications and delays of the law are difficult to follow, that the Supreme Court of the United States has finally rejected the application for a revision of the distribution of the Fayerweather estate, and that the colleges may now make use of the money they have received and will soon be given the balance due them.

THE will of the late Dr. Thomas Seton Robertson, which left the greater part of his property to the medical department of the University of Vermont, is being contested by his wife, against whom he had begun two years ago a suit for divorce.

A PSYCHOLOGICAL laboratory is being fitted up at Wells College, and a course in experimental psychology will be given by Miss Washburn, professor of philosophy.

MR. SWALE VINCENT, has been elected to the Sharpey Physiological Scholarship (£150 per annum), University College, London, which carries with it the post of chief assistant in the physiological laboratory. In the annual election for fellowships in St. Johns College the two fellows chosen were Mr. R. C. Maclaurin, (mathematics) and Mr. V. H. Blackman (botany).

PROFESSORS BEEBE AND PIERPONT have been promoted from assistant to full professors of mathematics in Yale University. In the same University Dr. G. P. Eaton has been appointed assistant in osteology in the Peabody Museum.

AFTER listening to a report on the condition of commercial education at home and abroad the New York Chamber of Commerce has, according to *Bradstreet's*, adopted resolutions advocating measures looking to the improvement of such education in the United States. Premising that the conditions of modern commerce and industry require wider knowledge and higher education on the part of business men, the resolutions declared that the present educational facilities afforded to business men in business colleges and similar institutions are inadequate and fail to equip them for competition in the world's commerce. The chamber went on record as favoring the establishment and development of sounder commercial education, both in secondary schools and higher institutions of learning throughout the country. The appointment was directed of a special committee to inquire further into the subject of commercial education, the committee being instructed to lay before the Chamber such plans as might best aid in attaining the end proposed. The superintendent suggested the inspection of commercial high schools by representatives of the Chamber, and the submission to such representatives of the courses of study prescribed there.

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## *DISCUSSION AND CORRESPONDENCE.*

### MEASUREMENTS OF PRECISION.

TO THE EDITOR OF SCIENCE: A communication in the current number of SCIENCE under the caption 'Measurements of Precision' and over the letter 'X' seems to call for some reply. I suppose that it is generally the case that the director of a laboratory assumes responsibility for articles emanating from his laboratory with his sanction—at any rate I am always willing to do so—and this is my reason for taking up this matter in place of Mr. Taylor. Of the general tone of the article in question I prefer to say nothing, leaving it to less interested persons to judge in the matter. I shall content myself with replying to the criticisms and questions of the writer.

The upshot of the communication, freed from the subtle vein of humor which runs through it, is that Mr. Taylor has committed the heinous offence of transcribing from his note-book more figures than the results justify. Perhaps the easiest way to treat this charge is to admit it at once, and thus clear the way. I am not, however, disposed to stop there, but shall consider the statements of 'X' as they are made. The first offence is that Mr. Taylor tabulates his measurements of the diameter of a cylinder twenty centimeters in diameter to '*thousandths and ten-thousandths of a millimeter*, thus implying that his measures are made to one part in two millions.' I have always urged upon my

students that they put down everything they do, so that it may be judged how it has been done. My views are that when one puts down figures that he did not observe he perpetrates a lie, but that when he puts down figures that do not agree, or carries them too far, he simply makes himself unnecessary labor, but deceives nobody. It is easier to throw off the unnecessary figures at the end than to find out what was observed if it is not stated. I presume that this will explain the reason for Mr. Taylor's putting down the readings of the micrometers of the cathometer as actually read, that is, to a thousandth of a millimeter. It is not stated that several settings would agree to this amount, but that the figures given are the means of several settings. In the next column, in which the ten-thousandth of a millimeter appears, 'X' might have noticed, with a little more careful reading, that the last figure is invariably a five or zero, as each entry is the mean of two. I am not aware what procedure 'X' would adopt in taking means. As the result of all the measurements of the coil, the mean diameter of the coil is presented to seven figures. Now it is not a little singular that in Lord Rayleigh's celebrated paper on Clark cells, in the description of the current-weigher, of which ours is a humble imitation, the mean radius of the two coils is given to exactly seven figures, the results being 'derived from the dimensions recorded in Professor Maxwell's handwriting in the laboratory note-book.' Lord Rayleigh did not even think it necessary to unwind the coil, and it evidently did not occur to him how mortified Maxwell would have felt had he been charged by 'X' with 'implying that his measures were made to one part in two millions.' Of course, Mr. Taylor ought to have known that what Maxwell could do he could not. I charge myself with remissness in not having impressed this upon him.

With regard to the inquiry as to the maker of the cathetometer, 'of a type so extraordinary as to justify these figures,' it was a fine instrument by the Société Genèvoise, fastened to the wall, a photograph of which appears in the May-June number of the *Physical Review*. The levels upon it were by the same makers, whose names there is no motive for concealing. With regard to the statement that a degree of change of temperature would probably change the length of the bar by fifteen or twenty thousandths of a millimeter, I find that, according to Benoît's results for steel, the part of the bar used would change by about *two* thousandths, so that 'highly perfected methods of determining the temperature' were not used. We have several thermometers capable of reading half-degrees.

The culmination of 'X's' sarcasm is, however, reached in the comment on the computation of the constant, in which it is stated that the last figure stands for *one part in thirty millions* (italics 'X's'). It is a fact that Lord Rayleigh only uses seven place figures, Mr. Taylor eight. These he took from Legendre's tables, throwing off the superfluous figures at the end, where the constant is given to *four* figures, not eight. If 'X's' representation in this case be ingenuous I prefer Mr. Taylor's deception. The fact that the computation 'made by other people and a different method' gives a result differing by one part in a thousand (not in five or six hundred, as stated by 'X') does not throw any discredit on the measurements, but shows that the approximation of the first mode of *computation* was not sufficient, as is plainly stated.

I will not stop to dwell on the comments on the weighings. They are of the same sort, and may be answered in the same way. To the last figure, although observed, no weight is to be attached. The supposed 'marvelous skill' required thus disappears. But to conclude: What, it may be asked, is the use of printing a paper in which the main result, as is frankly stated, is disappointing? To this I may make a brief answer, though it is not touched upon in the communication. The subject of the determination of current in absolute measure is one that is now very much in the air. It becomes important to know what is the best form of measuring instrument, and what is the best method of computation of the constant. To this matter some of the last work of Helmholtz was devoted. The question of computation has been attacked with great vigor by Principal J. Viriamu Jones. An elaborate current-weigher of the Rayleigh type was constructed by the

English Board of Trade. On my inquiring last year how the constant had been calculated I was informed by Principal Jones that it had never been calculated at all. It accordingly seemed to me that the record of any experience with current-weighers, seriously made, would be useful, and that something might be learned therefrom. The instrument in question was constructed four years ago, as a preliminary instrument. Mr. Taylor's experiments were all made before the constant was calculated. This was unfortunate, but unavoidable. When the computation was made it was found that the design of the instrument was unfortunate. Was all the work done, therefore, to be thrown away, or should it go on record for the possible information of others? What is shown by Mr. Taylor's paper is the accuracy with which it is possible to make and measure Cadmium cells, and a determination, by a method independent of the potentionmeter method, of their value in terms of Clark cells.

In conclusion, it is only fair to state that Mr. Taylor did not invent the practice of displaying more figures than are useful. In the very last edition of Everett's 'C. G. S. System of Units' still appears the quotation of Professor Miller's comparison of the pound and kilogram, in ten figures, although comparisons of three pounds at the Bureau International des Poids et Mesures differed in the fifth figure. Colonel Clark's comparison of the meter and yard is also given to nine figures. These figures have appeared for years in every British text-book of physics. We are told that death loves a shining mark. In this he apparently differs from our lively 'X,' who, instead of turning his attention to familiar instances, seems to prefer to make merry over a man appearing for the first time before the scientific community, who will presumably not hit back.

A. G. WEBSTER
(*alias* 'Y').

CLARK UNIVERSITY, November 7, 1898.

## A TRIP TO THE TERTIARY FORMATIONS OF WYOMING AND COLORADO.

THE Tertiary fossil beds of southwestern Wyoming have been of great interest to all paleontologists on account of the great beauty and the abundance of fossil fishes, plants and insects found in the shales of the Eocene period.

The fossils are darkened by much carbonaceous, organic matter, and are thus brought out in fine contrast and exquisite detail on the white, calcareous matrix.

The writer has always had a great desire to visit the locality, but found no opportunity of doing so until the past summer, when three weeks were spent in making excavations into the high bluffs to be seen from the station called Fossil, on the Oregon Short Line Railroad. The station is at an altitude of 8,000 feet. The fossil beds are nearly 1,000 feet higher, and above these beds are 200 feet of overlying rock. Much of this has to be removed to gain access to the fossils. The excavations are made on terraces, or shelves, along the face of the bluffs, and the work is quite laborious, and oftentimes very disagreeable from the dust constantly blown about by the wild winds of that region.

The locality is utterly barren and cheerless, the bluffs rising up from sand plains on which nothing grows but sage brush. Even in August and September it was quite cold, and icicles were hanging from the water tank at the station.

While on the bluff, three miles southwest of the station, we had our home in a stone house cut into the face of the cliff, the floor being the solid rock, on which we lay at night rolled up in our blankets. Every night the mountain rats swarmed in upon us, making it almost impossible to get any rest. All the water used had to be packed over from the east side of the mountain from the only spring of drinkable water in that vicinity; even this was quite alkaline. All these discomforts were cheerfully endured and compensated for, in making one of the finest collections ever obtained from that locality.

Beautiful palms and other plants, and hundreds of fishes and insects were obtained. From Fossil a trip was made into Utah, where some fine minerals were secured. After a week of rest at Salt Lake City the road homeward was taken, by way of the Colorado Midland, stopping over two weeks at Florissant, Colo., where over 700 beautiful specimens of fossil plants and insects were obtained from the