But since the students to be educated at Finsbury were largely of the higher artisan class, or at any rate were already familiar with machinery, perhaps I should rather put the matter conversely, and say that the object aimed at was to coax their already too material and concrete ideas towards something more generalised and abstract, by analysing into simplicity the complex machines with which many of them in their daily life had to deal, thus assisting them to grasp something of the theoretical physical principles underlying them all.

An admirable object, excellently carried out! Not a word have I to say towards minimising it: only do not let us minimise the work of others either.

November 21. OLIVER LODGE.

Apparent Decay of Radium.

I WISH to put on record an observation relating to the amount of "electrolytic gas" obtainable from a solution of radium bromide. Some four years ago, about 172 milligrams of radium salts, of which 152 were bromide and 10 sulphate, were enclosed in four small bulbs along with water, which dissolved the bromide, and in which the sulphate was suspended. These bulbs were sealed to a small Töpler pump, and for three years the mixed oxygen and hydrogen gases were pumped off at short intervals—about four days between two extractions. With the emanation accompanying this mixture various experiments were performed, an account of which has appeared in the Proceedings of the Royal Society and the Transactions of the Chemical Society.

In November, 1907, I received from the Vienna Academy what was supposed to be 0·5 gram of pure radium bromide; I was told that that was its weight in 1905. It weighed on receipt only 0·388 gram. This substance was washed into a bulb, and sealed to the pump, along with the other bulbs. The amount of gas collected from the larger quantity, however, did not appear to be proportional to its greater weight, and as analysis of a sample showed that it consisted largely of carbonate, insoluble in water, it was resolved to convert the carbonate into bromide by introducing into the bulb with a pipette some pure hydrobromic acid. (I may mention, parenthetically, that the small sample, converted into bromide, gained in weight to such an extent as to show that the original amount must have weighed 0·4971 gram, as $RdBr_2,2H_2O$.) The gas pumped off after this addition of hydrobromic acid contained much free bromine, but after a few weeks the evolution of bromine ceased, and "electrolytic gas" was produced to the amount of about 30 c.c. a week, always mixed with a small excess of hydrogen. This regular evolution continued from February until November 11. On that day the usual 30 c.c. of gas were pumped off; I have a note that "an unusually small quantity of hydrogen remained after explosion." On November 18 the gas was again pumped off; the quantity was approximately 13 c.c. Although it appeared unlikely that the tubes and taps should have been blocked, it was still possible. On November 25 the gas was again removed; its volume was about 1·5 c.c. At this stage air was admitted into the pump and the connected bulbs, and it was proved that there had been no stoppage. Advantage was taken of this to clean the pump and the connecting tubes, and to regrease the stop-cocks. The air was then removed completely by pumping. To-day (November 30) the gas was again pumped off; its volume was about 0·5 c.c. It still exploded, and left about half its volume of excess hydrogen.

Two alternative suppositions suggest themselves:—either the radium bromide, of which the apparatus contains 0·5071 gram, implying 0·2716 gram of metallic radium, has practically ceased to decompose water (about 25 c.c. of solution are present in the bulbs), or the reverse reaction, viz. the velocity of combination of oxygen and hydrogen to form water, has increased to such an extent as to reverse the decomposition.

It has been assumed that the life-period of radium is very long, say 2000 years, although Mr. Cameron and I, by measuring what we believe to be the true volume of the emanation, arrived at a considerably shorter period. Here, however, appears to be, on the first alternative, a proof that one of the ways in which the radium expends at least a portion of its energy has been stopped. It would be interesting to know if the other ways, say the evolution of heat or the emission of "rays," are similarly affected by time. WILLIAM RAMSAY.

University College, November 30.

Production of Helium from Uranium.

IN a paper in the October number of the *Philosophical Magazine* of this year I gave a preliminary account of some attempts to detect and measure the production of helium from the primary radio-elements, on which I have been engaged since 1905. The results given were few, and referred mainly to the element thorium. The following further results, obtained since the publication of the paper, with the element uranium carry the subject a stage further. The method is described in detail in the paper referred to. By special arrangements the solutions of the substances employed can be freed absolutely from air, and maintained in this condition indefinitely. After any desired period of accumulation the gases can be completely expelled by boiling the solution in a stream of gas from a voltameter. The expelled gases are freed from water by cooling, and then subjected to the action of the vapour of calcium in a special vacuum furnace, whereby all but the inert gases are perfectly absorbed. After cooling the furnace is filled with mercury, and the residual gas, if any, compressed into the smallest possible spectrum tube of lead glass. The minimum quantity of helium detectable in a successful experiment has been found by repeated trial to be 2×10^{-10} gram. Blank tests with a similar apparatus containing sodium sulphate solution were performed, and I feel confident that the data obtained are trustworthy.

I have used two separate quantities of uranium nitrate. The first and smaller had been carefully purified by Mr. T. D. Mackenzie by extraction with ether. It contained 340 grams of the element uranium. When it became evident that the rate of production was too slow to be conveniently estimated with this quantity, a second experiment on a much larger scale was started. The cost of this and similar other large-scale experiments was defrayed by a research grant from the Carnegie trustees. Four kilograms of uranium nitrate of good commercial quality, which had been re-crystallised from water, were employed. It contained 1850 grams of uranium. The preparation of the experiment and complete removal of air were effected by August 15 of this year. The first test for helium was performed after a period of sixty-one days. Helium in several times the minimum quantity detectable by the method employed was proved to be present in the extracted gases. The second test was performed after a period of twenty-seven days. Helium was again present, this time in quantity not much, if any, greater than the minimum detectable. The next test was performed after twelve days. No helium could be detected, although the experiment was a singularly perfect one. An experiment was then performed with the smaller quantity of uranium after a period of accumulation of 128 days. Helium was clearly detected, and its quantity estimated to be not greater than 1·5 times the minimum quantity.

The production of helium from uranium may therefore be considered to be established. With regard to the rate of production, the experiments show that this cannot be far from $2\times10^{-12}(\text{year})^{-1}$. That is to say, about 2 milligrams of helium are formed per year per million kilograms of uranium. The second test referred to shows that the rate is not less than 1·5. The third test shows that it is less than 3·3. The last test with the smaller quantity shows that the rate is not less than 1·7, and probably not greater than 2·5. It is of interest to note that the theoretical rate of production I recently calculated from the disintegration theory is $2\times10^{-12}(\text{year})^{-1}$, on the assumption that one atom of uranium produced but one atom of helium. These measurements, therefore, lend no support to the view, discussed in the paper referred to, that uranium on disintegration expels two helium atoms.

I may mention that I have commenced the observation of a quantity of sylvine (potassium chloride), one of the minerals investigated by Strutt, and regarded by him as exceptional in containing helium which cannot be ascribed to known radio-active changes. The tests so far indicate that the rate of production of helium from this substance, if any, is below $2{\cdot}5\times10^{-12}(\text{year})^{-1}$.

University of Glasgow. FREDERICK SODDY.