Transmutation of Elements.

SINCE the publication of my letter on the transmutation of lead in NATURE of May 1, 1926, I have continued the experiments in collaboration with Dr. A. Karssen and W. A. Frederikse. In the letter mentioned above I stated that our repeated experiments showed that the phenomena observed with the quartz-lead lamp and pointing to a transmutation of lead into mercury, were very difficult to reproduce. The lamp with which we obtained the photograms published was the tenth made after changing the construction from time to time to secure the most distinct results. In the hope of arriving at a still better method, and intending to distil off the mercury continually during the sparking process, the construction of the lamp was again changed. The result, however, was that, even without distillation, the lead spectrum now remained absolutely free from mercury lines.

After this very unexpected result, a lamp was constructed as nearly identical as possible with the lamp before the last modification was made. The behaviour of this new lamp was not quite the same as that of the old one; the discharges were different, the last contact was not made by a very thin jet of lead, and by oscillation all the gas was pumped out of the sparking space, which did not take place with the old lamp. Notwithstanding this, the appearance of mercury lines was again observed, but not so strong, and after much longer periods than before. From this we obtained the impression that the kind of discharge, being influenced by the construction of the lamp, was important here. To find another easily reproducible method, we tried now another construction which allowed sparking at high voltages, 160,000 volts and 10 milliamperes in a nitrogen atmosphere at different pressures between two solid lead electrodes, but the lead spectrum remained absolutely free from mercury lines.

Experiments of the same kind were carried out with a lamp in which the lead electrodes were heated above the melting point, but the results of all these experiments with long sparks and consequently with discharges of relatively small potential fall, gave only negative results.

In the meantime, as mentioned in another paper, we applied a different sparking method, using carbon disulphide as liquid dielectric. From the extra pure lead supplied by Kahlbaum, and treated by us in the way already described to remove every trace of mercury, two electrodes, 15 mm. thick and 2 cm. long, were made. These were mounted in two holders of steel, connected to two rods of steel, and all the steel parts were heated beforehand for twenty-four hours in an electric furnace at about 800° in an atmosphere of pure nitrogen. The steel-holders and rods treated in this way, and also the lead electrodes, were examined by the slightly altered method of Stock (*Z. f. anorg. Chem.*, **39**, 465 and 791; 1926) and appeared to be completely free from mercury.

Since it was possible that, for purification, the carbon disulphide had been shaken with mercury, sulphur was added and the solution was boiled for two hours in a flask with a reflux-condenser. The solution was then distilled, and 200 c.c. of the distillate was examined. No trace of mercury was found, whilst a quantity of 0·001 mgm. mercury would have been detected easily. Now we started our definite sparking experiments at 160,000 volts and 10-20 milliamperes. Since we wished to work at this voltage, and the dispersed lead soon diminishes, the electrical resistance of the dielectric, causing a decrease of the tension, every time, as the voltage began to decrease, the experiment was stopped until the dispersed lead had precipitated. After having sparked in this way discontinuously for one or two hours, the dispersed lead was gathered and examined. In 30 gm. of the mixture of dispersed lead and carbon, 0·1-0·2 mgm. mercury was found. The same result was obtained six separate times. Then our transformer went wrong, and it was some time before we could continue our experiments.

In the meantime I resolved to carry out an experiment, the results of which would be very convincing. It would be very important if it could be proved in repeating the experiment, after replacing only the lead electrodes by electrodes of another pure metal, of which no transmutation into mercury could be suspected, that the dispersed metal in this case is always free from mercury. I chose platinum; two platinum rods, 3 mm. thick and 4 cm. long, were mounted in the same steel-holders and the sparking experiments were repeated. The result was that the conglomerate of dispersed platinum and carbon was found to be free from mercury.

On repeating this experiment, the result was the same; and the conclusion consequently was, that the mercury found in our sparking experiment with lead electrodes must have been formed from lead. I intended to send now a preparation of our mercury to Dr. Aston, whom I had asked to examine it in his mass spectrograph, but I preferred not to do so before we had repeated the platinum experiments several times. The third sparking experiment with platinum electrodes and with a new quantity of purified carbon disulphide gave, however, not a negative but a positive result, *but not so strong as we found in our experiments with lead electrodes.*

Taking for the fourth experiment the carbon disulphide previously used in our third experiment, the result was again negative. From this it follows that the *new* quantity of carbon disulphide must have contained a trace of a mercury compound, probably a volatile organic one, which was not removed by the purification method applied, and it had escaped detection. Since the positive result, after sparking with platinum electrodes, had disappeared, it seemed that this mercury compound could be dissociated and removed by strong electrical discharges, and therefore we resolved to purify the carbon disulphide in future by the sparking method with platinum electrodes. The result of this method was excellent. After having sparked 750 c.c. of carbon disulphide for 1½ hours, the conglomerate of dispersed platinum and carbon was separated from the liquid, and the liquid was distilled. The distillate proved to be free from mercury. This was found not only by direct chemical analytical examination, but also by submitting the carbon disulphide to a repeated sparking process between platinum electrodes, and by examination of the conglomerate of platinum and carbon formed—about 7 grams. The conglomerate was now completely free from mercury. This carbon disulphide purified by electrical discharges was used in our next experiments with lead electrodes, 1 cm. thick and 3 cm. long. These experiments, repeated several times, have so far given only negative results. At the moment I am, therefore, inclined to conclude that the mercury found in our earlier sparking experiments came, certainly partly and perhaps entirely, from the carbon disulphide. This seems possible, since in these experiments a used quantity of carbon disulphide was supplemented by a new quantity of carbon disulphide purified in the ordinary way. But there is still this difficulty, that after sparking between the lead electrodes in carbon disulphide, purified in the usual way, the reaction was *stronger* positive than

after sparking in this dielectric between platinum electrodes, in the same circumstances as regards voltage, current strength, and time. Consequently, there is still an uncertainty, which probably will be solved by our continued investigations.

Though the experiments, which have been mentioned here very shortly, have taken a full year, they are only the beginning of detailed investigations in different directions. Still, I feel obliged to make this communication, since I know that other investigators are repeating our sparking experiments with carbon disulphide.

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Thyroid Gland and Plumage in Chickens.

IN a series of experiments now being carried out with Brown Leghorn chicks concerning the relation of thyroid gland to plumage characterisation, some interesting results are already apparent in the thyroidectomised females. The operation was carried out when the birds were 6 weeks old, and 3 weeks after

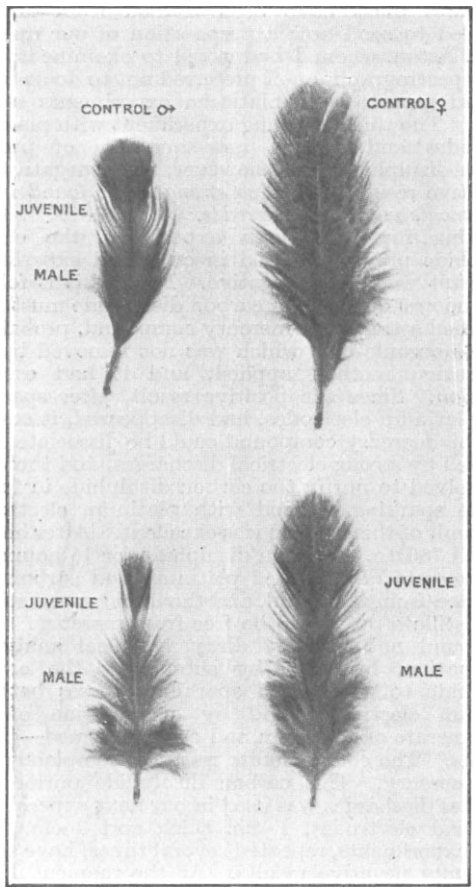

FIG. 1.—Wing contour feathers from Brown Leghorn chicks 10 weeks old. Upper figures, controls; lower figures, thyroidectomised female operated on at 6 weeks old.

the operation the effect on the plumage became visible. Changes in coloration first appear in the contour feathers of the wing, shoulder and cape, the whole forming a continuous arc of brightly coloured feathers from one wing edge to the other when the bird is examined with the wings outstretched. Examination of control male chicks at the same time showed a similar continuous band of brightly coloured feathers replacing the juvenile plumage in these areas, while no such band was present in the control females. In the region of the saddle, brightly coloured feathers were also observed in the thyroidectomised females and in control males, while being absent in control females.

When the feathers were sufficiently grown to determine their shape, it was seen that the majority of these brightly coloured feathers have the blunt tip characteristic of the juvenile feather. At a short distance from the tip, however, the shape changes abruptly, and in the proximal portion the feather is very similar to the typical male feather from the same regions, *i.e.* it is heavily fringed and tapers almost to a point at the junction with the distal juvenile portion. This condition is also found in feathers from control males of approximately the same age (Fig. 1). The coloration of the male-like feathers in the thyroidectomised females, while markedly differing from female colouring, is not quite so deep as that of the feathers from control males.

It would appear thus that the removal of the thyroid gland from Brown Leghorn female chicks leads in the first place to the assumption of plumage of a type approaching in colour and form that of the male. These results are of special interest in view of the recent work on the effect of thyroid feeding on the plumage of the fowl.

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Ultrasonic Stationary Waves.

THE observations described in the striking experiment of Hubbard and Loomis (NATURE, Aug. 6, 1927, p. 189) are another example of the important conclusions which may be derived from a study of the interesting phenomenon of ultrasonic stationary waves. Velocities of sound in various liquids were determined here by the ultrasonic stationary wave method some years ago; some of these results have already been published (*Trans. Roy. Soc. Can.*, **3**, 141; 1923; 159, 191, 197; 1925; 79; 1927); others were reported to the Canadian Research Council (Report, Boyle and Morgan, 1924). The 'detector' of the standing waves in these experiments was 'nodal dust figures,' something like the figures in a Kundt's tube, but less precision was claimed for the results than is claimed by the authors above.

Pierce also carried out very precise experiments on the velocity of sound in gases (*Proc. Amer. Acad.*, **60**, 6, 271; 1925) by the ultrasonic method, the detector of the standing waves in his experiments being a milli- or micro-ammeter in the associated grid-circuit of the electric generating tube. In fact, Hubbard and Loomis's experiment does for liquids what Pierce's did for gases, with the exception that their standing wave indicator is a neon tube instead of a milli-ammeter.

The purpose of this note is to point out that the presence of these ultrasonic stationary waves in a liquid can easily be demonstrated and visualised by making use of another phenomenon, namely, that of ultrasonic cavitation, or the production of bubbles in the liquid by the waves themselves. In our work in this laboratory nodal layers of bubbles, a half wave-length apart, have been produced in a tank of liquid between an ultrasonic generator and a reflector; and some months ago Messrs. Taylor and Sproule arranged an apparatus for ultrasonic waves in which a bell-jar