alloy or a mineral, only those have recommended themselves to me which depend upon the use of solutions; and for the reason that most alloys are not homogeneous, and the portion of a metallic electrode exposed to the action of the spark is volatilised from one point, and is too minute in quantity to represent the composition of the mass. Now, the composition of a solution represents in every part the composition of the entire mass dissolved; it is, therefore, quite unimportant how small a fraction of it is used for the purpose of obtaining the spectrum of its constituents.

It is a remarkable fact that at the present time we know little or nothing of the sensitiveness of the spectrum reaction *under various conditions*, notwithstanding that such knowledge is absolutely necessary for the purpose of giving stability to numerous theories and arguments which are based on spectrum observations. I have made some experiments in this direction by determining the extent of dilution which serves to modify in various ways the spectra of solutions of metallic salts, and that which finally causes the extinction of the most persistent line or lines. The sensitiveness of the reaction varies with different elements and with the period of exposure, the intensity of the spark, and other conditions; I have no difficulty whatever, when working in the manner here indicated, in recognising spectra yielded by solutions which contain no more than $\frac{1}{1000}$th of a *per cent.* of calcium, silver, copper, and $\frac{1}{10000}$th of a *per cent.* of manganese. It is necessary, however, for me to withhold a full account of my experiments until I have determined the wave-lengths of the lines in the various spectra under observation, for it is quite impossible to describe the changes in the spectra without reference to accurate measurements of the metallic lines. For some time past Mr. W. E. Adeney has been working in conjunction with me at these determinations, and I hope with as little delay as possible to have the honour of submitting to the Royal Society all details here omitted, both with regard to these new methods of analysis, and the wave-length determinations.

## II. "On the Reversal of the Metallic Lines as seen in Over-exposed Photographs of Spectra." By W. N. Hartley, F.R.S.E., &c., Professor of Chemistry, Royal College of Science, Dublin. Communicated by Prof. G. G. Stokes, Sec. R.S. Received May 19, 1882.

In preparing series of photographs of metallic elements when their spectra are obtained by the action of a condensed spark passed between metallic electrodes, I have been very careful to ascertain the exact period of exposure of the sensitive plate to the rays, which will bring

out the most characteristic lines without the additional diffused rays of the air-spectrum; at the same time very delicate and feeble air-lines are adequately shown. This has always been accomplished by making a series of *comparative exposures*. With gelatine emulsion dry plates great latitude in exposure is capable of yielding perfectly satisfactory photographs. An under-exposed plate is not easy to develop, in order that the usual density for the strong lines as seen in a good negative may be gained. The air-lines are generally very feeble or altogether omitted. An over-exposed plate is likewise difficult to develop; it yields a thin flat image, and more or less marked indications of a continuous air-spectrum are seen.

Over-exposure, even when not excessive, is liable to cause strong lines to appear reversed. I have mentioned in my paper "Notes on Certain Photographs of the Ultra-Violet Spectra of Elementary Bodies" ("Journal of the Chemical Society," vol. xli, p. 89, 1882), that sometimes lines appear reversed in one photograph, but not in another. This did not seem at all likely, or even possible, to be caused by over-exposure, because the two periods differed only by a minute; but I have small doubts now on the matter. The conversion of what is called a negative into a positive image by excessive exposure has been already noticed by Mr. C. Bennett ("British Journal of Photography," 1878), by Captain Abney, who investigated the nature of the change ("Phil. Mag." [5] 10, p. 200), occurring in the sensitive film, and by M. Janssen ("Comptes Rendus," 90, pp. 1447—1448).

In illustration of this phenomenon, I may mention a remarkable result I obtained on one occasion when photographing a landscape. I endeavoured to secure a picture with detail in a shaded foreground, and a direct view of the setting sun, with mountains in the middle distance, and strongly illuminated as well as dark clouds. In one case I succeeded remarkably well, but in another plate the foreground was good, but the sun was completely reversed. The negative image was clear glass and the sun printed black. What should have been a negative in the strong lights became a positive. Again, by exposing a plate to the cadmium spectrum, the whole of the metallic lines were rendered distinctly, but with a flatness and want of density, the whole of the strong air-lines at the least refrangible end of the spectrum were, however, completely reversed.

*Any strong lines may be reversed by over-exposure without materially altering the appearance of the rest of the spectrum.* This is particularly the case with the lines of the metals magnesium, aluminium, and indium, but particularly so with magnesium. The reversal takes place in the centre of the line, that is to say, where the radiation is most active. Except by the method of comparative exposures, which I have always employed, it would be impossible to say whether a reversal was due to an absorbed ray or an over-exposed plate.

M. Cornu has shown that the quadruple group of rays in the magnesium spectrum may become quintuple or sextuple, according to the increased intensity of the spark employed. This is precisely what might happen if one reversal by over-exposure were followed by a second. Such reversals might be looked for if under the conditions of the stronger spark the exposure of the plate were not shortened, because the first and third of the four lines are stronger than the other two, and they would therefore be the first and second to suffer reversal. The reversal would split the lines in two, and hence produce the appearance of a sextuple group. In order to ascertain whether this might readily occur in the magnesium spectrum, some observations were made with plates containing several photographs obtained by different periods of exposure. Thus the first spectrum was the result of ten seconds, the second of half a minute, and others various times extending to half an hour. The quadruple group was not affected in the way observed by M. Cornu, from which fact it would appear that the division of the lines was caused by a reversal which was the result of absorption of the central portion of the ray or rays. In the two photographs obtained by the longest exposures, especially in the last, the triplet $b'$ between K and L became a quadruple group by reason of the most refrangible line being split into two by a reversal, the cause of which was nothing more than over-exposure. In the quadruple group previously mentioned the lines were totally reversed or not at all. This subject of reversal by over-exposure is one well deserving the attention of those who are engaged in the study of solar physics. Comparative exposures should be methodically employed to confirm the accuracy of observations made entirely by the aid of photographic representations of spectra. Especially is this desirable when gelatine or other dry plates containing organic matter are in use.

III. "Experiments on the Value of the Ohm." Part I. By R. T. GLAZEBROOK, M.A., Fellow and Assistant Lecturer of Trinity College, Demonstrator at the Cavendish Laboratory, Cambridge, and J. M. DODDS, B.A., Fellow of St. Peter's College. Part II. By R. T. GLAZEBROOK, and E. B. SARGANT, M.A., Trinity College. Communicated by LORD RAYLEIGH, F.R.S. Received May 24, 1882.

(Abstract.)

The method of the experiments is a modification of those of Kirchhoff and Rowland.

Two coils of copper wire of about 25 centims. radius, each containing