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XXVII. *The Passage of α -Particles through Photographic Films.*

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THE photographic action of α -particles was first studied in detail by Kinoshita,* who showed that, whenever an α -particle, strikes a grain of silver halide in a photographic plate, that grain is subsequently capable of development. It was also shown that this was the case throughout the range of the α -particle in the gelatin. It therefore seemed probable that the path of an α -particle, projected tangentially to a photographic film, would, after developing the plate, be seen under a microscope as a trail of grains. This effect has been observed by Reinganum† and the method has been employed by Michl‡ and Mayer§ to detect α -particles; but microphotographs demonstrating the phenomenon do not seem yet to have been obtained. In some experiments upon which we were engaged, it became necessary to examine microscopically photographs taken with very weak sources of α -radiation and it occurred to us that it might be of interest to obtain microphotographs of the trails which could be clearly seen in the films.

As a nearly pure source of α -radiation of fairly long range, a flat metal plate was exposed for a few seconds to a fraction of a millicurie of radium emanation and then immediately placed in contact with an Ilford process plate. The α -rays from the radium A on the metal surface produced a photographic impression on the plate which was just visible to the naked eye after development. Under the microscope this faint impression was seen to consist of a multitude of definite tracks passing through the film at all angles. A microphotograph of the film taken with a $\frac{1}{8}$ in. objective is reproduced in Fig. 1. It was found best to use this relatively low-power objective for, as the grains of silver affected by the α -particles were at different depths in the film, it was impossible to focus all the grains simultaneously when using an objective of higher power. The photograph confirms in a striking manner the conclusions

* Kinoshita, "Proc." Roy. Soc., A83, 432, 1910.

† Reinganum, "Phys. Zeits.," 12, 1076, 1911.

‡ Michl, "Wien. Ber.," 2A, 1431, 1912.

§ Mayer, "Ann. d. Phys.," 41, 5, 931, 1913.

drawn by Kinoshita which have been mentioned above. Careful examination of Fig. 1 shows that many of the α -particles, after traversing the film in straight lines for some distance, suffer sudden deflections, thus illustrating the well-known effect of scattering; but the great number of the tracks on this photograph and the smallness of the magnification make it difficult to follow out these details easily. Moreover, the α -particles penetrate the film in all directions, so that only a relatively small number leave tracks sufficiently nearly parallel to the plane of the film to be examined throughout their lengths. On this account the photographic impression produced just outside the edge of the active plate was examined; for in this region the density of the tracks is much smaller and a greater proportion of the α -particles producing them were travelling parallel to the plane of the film. A microphotograph similar to that shown in Fig. 1 was taken of this region of the photographic plate and a few isolated tracks were again magnified by photography with an ordinary camera. Three such tracks are shown in Figs. 2, 3 and 4, which show the phenomena in greater detail. In the cases of the tracks shown in Figs. 2 and 3 the magnification was measured by determining the lengths of the paths on the original photographs with a graduated scale in the eyepiece of a microscope. The magnification in Fig. 2 was found to be 1,650 diameters; that in Fig. 3 was 1,800. It will be seen that the magnification in Fig. 4 is slightly less. The large spots seen on Figs. 3 and 4 near the tracks are due to minute particles of dust on the original photograph.

Some difficulty was experienced in making sure that the tracks showing deflections were due to single α -particles and not to two particles passing through the film in different directions. There is no means of deciding this point from a study of the microphotographs, but it is an easy matter to trace out the complete path of an α -particle throughout its length by visual observations through a microscope. For as a rule the grains in any track are not precisely at the same depth in the film and it is possible by careful focussing to ascertain whether an α -particle has been steadily penetrating into the film or emerging from it. In cases in which two tracks crossed each other, at the point of apparent intersection the grains due to the two α -particles were in general seen to be at quite different depths in the film.

This method of studying the projection of α -particles through matter shows many of the characteristics demon-

FIG. 3.

FIG. 4.

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strated by C. T. R. Wilson* in his beautiful photographs of the tracks of α -particles through air. The method just described possesses, however, the advantage of great simplicity, and may prove of use in studying the scattering of α -particles produced by heavy substances, such as silver.

ABSTRACT.

It has been shown by Kinoshita that when an α -particle strikes a grain of silver halide, that grain is subsequently capable of photographic development. It therefore seemed probable that the path of an α -particle projected tangentially to a photographic film should, after development, be visible under a microscope. This was shown to be the case, and micro-photographs showing the tracks of α -particles through a photographic plate have been obtained. The effect of "scattering" of α -particles can also be seen in the photographs and this method may prove of use in studying the scattering of α -particles by heavy atoms such as silver. This method of studying the path of an α -particle possesses the advantage of great simplicity.

* C. T. R. Wilson, "Proc." Roy. Soc., A87, 277, 1912.

FIG. 1.

FIG. 2.

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