A satisfactory test of the above hypothesis would require experimental values for Q or for dp/dT, as well as a more detailed knowledge of the laws governing the flow of liquid helium II.

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Photographic Tracks from Cosmic Rays

While examining some photographic plates which had been exposed to cosmic radiation, a peculiar grouping of tracks of very short range was observed, which may possibly be due to a novel effect.

The plates were half-tone Ilford plates (70 μ thick): they were protected by a layer of glue-free paper and then covered with layers of pure paraffin in varying thickness, from 1 mm. to 15 mm. The packets were exposed to cosmic rays at 3,400 metres altitude at the Institut für Strahlungsforschung on Jungfraujoch. I am glad to express here my gratitude to the Director and the assistants there for their kindness and help.

After an exposure of five months the plates have now been developed and examined. They present singular tracks and stars like those reported in previous papers[1]; but besides these, many groups of very short tracks are seen for which no parallel has been observed in earlier experiments. The number of individual tracks in one group was in general four to eight, certain groups showed up to twenty or thirty, and a few were so dense that individual tracks could be distinguished only in the peripheral parts, while the inner parts were visible as black spots, even to the naked eye. The range in air corresponding to the length of the tracks is of the order of 1 cm. or less; the tracks diverge from closely situated points in the photographic emulsion, sometimes two tracks arising from one point. The number of groups seems to increase with the thickness of the paraffin. With lead as absorber, or without absorber, only very few groups with a small number of tracks have so far been found.

The first question which arises is, whether the groups could be due to contamination from radioactive substances, either in the paper or in the paraffin. This, however, seems not to be possible for two reasons. (1) The tracks do not start from the surface of the emulsion, but at a certain distance below the surface—generally 8–10 μ; groups with a limited number of tracks have also been observed at greater depths—even 30 μ below the surface. Such an effect might be due to an accidental desensitization of the uppermost layer of the emulsion, say, by pressure from the paraffin, but such a desensitization can scarcely be admitted here because reduced silver grains are often found between the group of tracks and the surface. (2) The very short range of the tracks; they could in fact only be due to heavy contamination with samarium, which is highly improbable, while it would also be necessary to admit that groups of samarium atoms had diffused below the surface of the emulsion. Moreover, direct experiments with samarium as contaminating substance have never given a corresponding effect.

As a first tentative explanation it may be suggested that cosmic rays give rise in the paraffin to a secondary radiation, which in turn leads to disintegration processes of the atoms in the photographic emulsion. The group tracks would then be due to slow-moving disintegration particles.

This is corroborated by the fact that inside the groups, between the tracks, silver grains, both single and double, are observed much more frequently than outside; this reduction of silver of course would be due to the action of electrons, γ-rays or heavy particles of very short range resulting from the disintegration process. This and other alternative explanations will be discussed in a detailed report, when further observations have been collected.

The examination of plates has been carried out in the Universitetets Kjemiske Institutt, Blindern pr. Oslo, and I wish to express my sincerest gratitude to Prof. Ellen Gleditsch for her kind hospitality that has made it possible for me to continue my investigation.

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Generation of Auroras by Means of Radio Waves

About a year ago, attention was directed to a new mathematical theory of radio-interaction[1] which, contradicting the original mathematical theory[2], leads to the important conclusion that abnormally large impressed modulations may be caused by waves the frequencies of which are nearly equal to the local gyro-frequency (that is, the frequency of gyration of a free electron in the earth's magnetic field). This conclusion was strikingly confirmed in the course of experiments[3] carried out in March 1937.

It is therefore now appropriate to mention other deductions from the new theory which will be of general interest.

Since a gyro wave (that is, one with frequency nearly the same as the local gyro-frequency, $He/2\pi m$) can cause such notable effects in the E layer, it is natural to inquire about the details of a radiator of gyro waves which would be capable of generating a visible glow discharge in that layer.

From the results of the experiments of H. A. Wilson[4] with discharge tubes containing air at low pressures and from generally accepted knowledge about the ionosphere and radio waves, it can be deduced that at night, in latitudes where the terrestrial magnetic field is approximately vertical, a visible glow discharge usually can be produced near the lower part of the E layer by means of a radio station which radiates an appropriate circularly polarized vertical beam of gyro waves at the rate of 500 kilowatts by means of an aerial system consisting of 800 horizontal half-wave aerials lying in a plane situated one quarter of a gyro wave-length above the ground.

This aerial system would have approximately the appearance of a square network with a side 2 kilometres long, a mesh of 100 metres and an elevation of 50 metres. About half the beam would be contained mostly within a cone of vertical angle equal to 6°, and the resultant celestial glow discharge would lie below the height of 100 kilometres and be about fifty times as bright as the sky on a moonless night.