LETTERS TO THE EDITORS

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Fluctuations in Cosmic Radiation at Radio-Frequencies

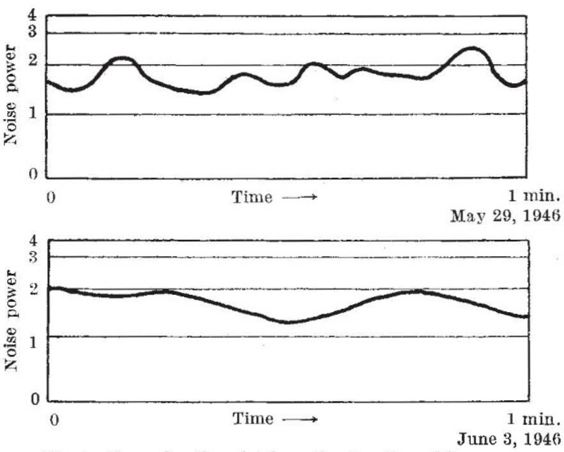
In a previous publication[1] we described the results of an investigation into the spatial distribution of cosmic electromagnetic noise radiation at 5 metres wave-length. We have recently been engaged in an attempt to make a more detailed determination by using a more sensitive receiver of narrower beam-width. An interesting new feature which has emerged from these latter experiments is the occurrence of short-period irregular fluctuations which have been found to be associated with the direction of Cygnus. This region, which is a secondary peak in the cosmic noise distribution, appears to be unique in being characterized by short-period variations of marked amplitude in the intensity of power flux.

A watch on this region has been kept intermittently during the last four months. The receiving apparatus, situated in Richmond Park, has an aerial beam rotatable in bearing but fixed in elevation at an angle of 12°. The region of the fluctuations ascended and descended through the aerial beam on bearings 30° and 330° respectively. The corresponding times were 0100 hr. and 1900 hr. G.M.T. in February, when the watch was commenced, while in June they were 1800 hr. and 1200 hr. G.M.T. Care was taken to avoid including recordings taken in daylight periods when the powerful solar noise emission associated with the great sunspot in February was also present. Since the observations covered a wide range of bearings and solar times, we were able to rule out the possibilities of terrestrial or solar causes, and the interpretation of the results was consistent only with an origin in the direction of Cygnus.

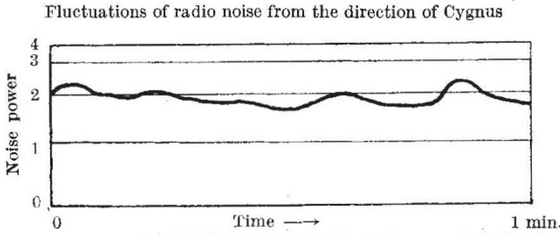
It is not easy to determine the bearing of a source of irregular disturbance with a high order of accuracy unless an exceptionally narrow beam is used. The aerial of the equipment has a beam width of approximately $\pm$ 6° to half power in bearing and elevation, and the average of a large number of observations indicated a source of disturbance subtending an angle not exceeding 2°. There may be other areas of occasional fluctuation in the immediate vicinity (within 8°).

The average amplitude of the fluctuation is 15 per cent of the mean power received. If the disturbed area be assumed to extend over a circle of angular diameter 2°, then this solid angle is 1/36 of that for the equivalent acceptance cone of the aerial beam. The variations in power per unit solid angle therefore correspond to more than five times the mean power per unit solid angle for the whole beam. The centre of the region is approximately R.A. 2000 hr., Decl. + 43°. The type of fluctuation, which itself varies from day to day, is illustrated in the accompanying figure. The noise from Sagittarius would, by comparison, appear as a straight line on a diagram of this scale.

It appears probable that such marked variations could only originate from a small number of discrete sources. This suggests at once the analogy with the radio-frequency sunspot radiation[2,3,4]. The solar radio noise from sunspots is also characterized by strong fluctuations. A recording of these solar radiations, taken on July 2, is also shown in the figure. On the other hand, Greenstein, Henyey and Keenan[5] have recently pointed out the difficulties in attempting to account for the magnitude of cosmic radiations in terms of the solar phenomena; further, they direct attention to the close agreement between experimental observations of cosmic noise intensity and their calculations of the expected interstellar radiation arising from free transitions of electrons in the field of protons. A theory in terms of widely distributed interstellar matter does not, however, appear readily to account for the localized disturbances just described. These fluctuations therefore appear of special importance in that they may prove particularly relevant to the explanation of the origin of cosmic radiations at radio frequencies.



Fluctuations of radio noise from the direction of Cygnus



Fluctuations of solar radio noise July 2, 1946

We are indebted to the Director General of Scientific Research and Development (Defence), Ministry of Supply, for permission to publish this communication.

J. S. Hey
S. J. Parsons
J. W. Phillips

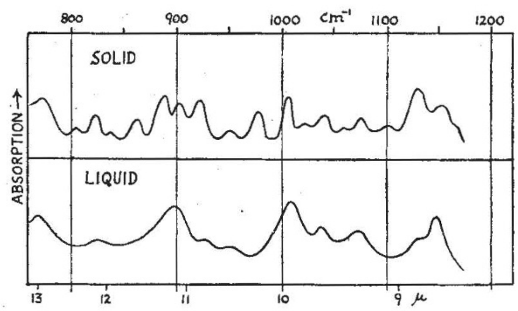
Ministry of Supply.
July 4.

[1] Hey, Parsons and Phillips, *Nature*, **157**, 296 (1946).
[2] Appleton, *Nature*, **156**, 534 (1945).
[3] Hey, *Nature*, **157**, 47 (1946).
[4] Pawsey, Payne-Scott and McCready, *Nature*, **157**, 158 (1946).
[5] Greenstein, Henyey and Keenan, *Nature*, **157**, 805 (1946).

Infra-Red Spectra and State of Aggregation

Recent work in this Laboratory has shown that the infra-red spectrum of a substance may differ markedly according to the particular state of aggregation—gas, liquid or solid—in which it is measured[1]. The interpretation of such changes has become especially significant in connexion with the correlation of spectra with molecular structure, particularly when dealing with polymers, resins and plastics; but the principles underlying the phenomenon are of fundamental importance and must involve a consideration of the degree of molecular order in the different states of aggregation.

In order to examine this phenomenon in greater detail, a survey is being made of the spectra of some simple molecules as solids and liquids. With polar substances the spectral differences found are not surprising, but they have also been found with a number of non-polar substances. For example, there are marked changes in the case of 3-ethyl tetracosane, the spectra of which between 8–13 μ are shown. It should be noted that not only do new bands appear with the solid, but there are some differences in relative intensity of bands in the two states, even though the frequencies may be little affected.



Spectra of 3-ethyl tetracosane

The extent to which the spectrum is affected by the change of state varies with the particular molecule concerned, and with branched paraffins, for example, appears to depend upon the extent and positions of branching. Similar measurements have recently been described by Halford and Schaeffer[2] with benzene, and substantially the general conclusions drawn by them appear to apply to results found for other hydrocarbons. As pointed out in an earlier paper[1], the passage from one physical state to another will involve a change in both the potential energy function of the system and of the selection rules, and with a long branched paraffin chain the frequencies and intensities of the bands may be expected to change.

Further examples of this phenomenon will be considered in detail later.

H. W. Thompson

Physical Chemistry Laboratory,
Oxford.
July 13.

[1] Thompson, H. W., and Torkington, P., *Trans. Farad. Soc.*, **41**, 259 260 (1945); *Proc. Roy. Soc.*, A, **184**, 15 (1946).
[2] Halford, R. S., and Schaeffer, O. A., *J. Chem Phys.*, **14**, 141 (1946). Halford, R. S., *J. Chem Phys.*, **14**, 8 (1946).

High-Frequency Resistance of Superconductors

Measurements by H. London[1] on the heating of superconducting tin by high-frequency electromagnetic fields indicate the presence in the superconductor of some mechanism which enables it to absorb a measurable quantity of energy from the field provided the frequency is of the order of 1,000 Mc./sec. or more. Recent developments in radio technique have made it possible to employ a resonance method to investigate the effect, and this communication describes preliminary work at frequencies around 1,200 Mc./sec., corresponding to a free-space wave-length of 25 cm. The specimens were polycrystalline thin wires contained in quartz capillary tubes for rigidity, bent into a narrow U