one of group D. In traversing the atmosphere, they suffer both a slow loss of energy and also large collision losses due to the formation of secondary electrons and photons. The coefficients of absorption for the electrons are about 5×10^{-3} cm.²/gm. and for the protons $0 \cdot 7 \times 10^{-3}$ cm.²/gm. In light elements, the absorption of both components is nearly proportional to the density of the absorbing material. The greater the absorbing material traversed, the stronger is the component D relative to M, until, under 20 metres of water below the top of the atmosphere, M has nearly disappeared[2]. In dense matter of low atomic weight (water, earth, etc.), the formation of secondaries (electrons and photons) at close intervals determines the creation of multiple rays capable of producing coincidences in counters placed out of line.

If the two groups of rays traverse heavy elements such as lead, they behave quite differently. The absorption of the D particles is proportional to the mass of matter traversed, and is accompanied by the formation of secondaries and perhaps of showers, as in light elements. The M particles, on the other hand, suffer very intense absorption due to the emission of radiation during nuclear collisions. The photons produced have a short path in lead and give rise to numerous electron-positron pairs. This is the origin of the typical shower, such as determines the typical maximum of Rossi's curve.

The concentrated type of shower can be attributed to the occurrence of an absorption process in the interior of a piece of heavy material, and the diffused shower to an absorption process occurring near a free surface, so that the ejected photons spread out and are then absorbed by surrounding dense objects. After the decrease which follows the maximum of the curve of showers, that is after 6 cm. of lead, only component D remains, and the remaining multiple coincidences are to be attributed to secondary effects of this component, with possibly a few showers. Rossi's curve is really due to the superposition of the multiple secondary effects of M and of D. If one works at a place where M has disappeared, no typical maximum is found, but only the effect of D.

The absorption of the two groups of particles can be studied by the interposition of screens between the counters as arranged vertically for counting coincidences. The curves so obtained for lead show an initial rapid decrease due to the absorption of the secondary rays, and of group M, and then after 10 cm. a slow decrease due to D. With matter of lower atomic weight, such as copper, one obtains different curves, in which the rapid decrease due to the absorption of the secondaries is followed by that of group M, and after 20 cm. by the slow decrease due to D.

Actually the collision absorption, which increases with the atomic number of the atoms forming the screen, is much smaller in copper, corresponding to the smaller production of showers. One can show by absorption in lead that after traversing 8 cm. of copper, there still remains a considerable part of M; the rapid decrease which additional lead then produces is the same as that at the start of the absorption curve in lead. After M has disappeared, the component D continues alone, with the same mass absorption coefficient in all materials.

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[1] P. Auger, *C.R.*, **200**, 739; 1935.
[2] P. Auger, A. Rosenberg and F. Bertein, *C.R.*, **200**, 1027; 1935.

Cosmic Rays and Novæ

In dealing with this subject in a recent letter[1], I most unfortunately overlooked some recent work of W. Baade and F. Zwicky[2]. These authors have advanced the highly interesting theory that cosmic rays have their origin in outbursts of *super*-novæ in extra-galactic nebulæ, and did so a year before the appearance of Nova Herculis prompted a search for a possible connexion between cosmic rays and nova phenomena in general. Super-novæ are thought to occur in each nebula about once in a thousand years, and, from certain hypotheses about what happens during an outburst, Baade and Zwicky show that they probably release energy sufficient to maintain the supply of cosmic radiation as observed at the earth.

I should emphasise that in my own note I offered no theory of the origin of cosmic rays, but sought merely to answer the question: Can ordinary nova outbursts in our own galaxy supply energy sufficient to give the observed intensity of cosmic radiation? I expected a negative answer. The method I followed in estimating the energy is due to Milne, and is independent of any hypothesis as to what happens actually during a nova outburst. It turned out in point of fact that, on the present knowledge of stellar structure, one cannot definitely exclude the possibility of this source of the radiation, *on energy considerations alone*.

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[1] Nature, **135**, 371, March 9, 1935.
[2] *Proc. Nat. Acad. of Sci.*, **20**, 254, 259; 1934. *Phys. Rev.*, **45**, 138; **46**, 76; 1934.

The 'Lipotropic' Effect of Protein

Evidence that proteins or substances closely associated with proteins exert a 'lipotropic'* effect has been reported previously from these departments[1,2]. In the latter paper it was shown that when rats with fatty livers were placed on a choline-free diet consisting exclusively of sucrose, an increase of some 8 per cent of liver 'fat' was observed to take place within six days. In a comparable experiment in which the ration contained 20 per cent protein as 'fat-free and vitamin-free casein' and 80 per cent sucrose, no increase in liver fat was observed at the end of six days. It was also shown that 5 mgm. of choline exerted a very definite effect on the liver fat of animals receiving a diet low in choline and containing 20 per cent fat. This effect may be regarded as much greater than that of the casein, and the results of more recent experiments indicate that as little as 1 mgm. of choline daily exerts at least as great a 'lipotropic' effect as 2 gm. of the alcohol and ether washed casein which we have used.

In several series of hitherto unpublished experiments in which large groups of animals were used, extensive deposition of liver fat has been obtained consistently with diets low in 'lipotropic' factors but containing 15–21 per cent protein and 3–40 per cent

* The term 'lipotropic' is used to describe substances which decrease the rate of deposition and accelerate the rate of removal of liver fat.