tracks entering the emulsion in the field of view at about the proper angle are recorded, followed, and identified. Mesons are always identified well before their endings. In the 600μ plates, about 40 percent of the entering tracks are mesons, of which about 40 percent stop in the emulsion.

Factor (b) is met by the collimating system which defines conditions such that 90 percent of the stopped mesons have their entrance directions and ranges well defined for each X. Mesons falling outside these limits are not counted. A few μ-mesons, formed in flight, gave tracks of type B and C, but, as expected, had considerably different ranges than the π-mesons. These investigations are being continued.

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Paramagnetic Resonance at Very Low Fields

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We have observed a very strong and narrow paramagnetic resonance absorption line at fields from 7.0 to 10.3 gauss (i.e., at frequencies of about 19.5 to 29.5 Mc) in a one-gram sample of the free radical α, α-diphenyl β-picryl hydrazyl, $(C_6H_5)_2N-NC_6H_2(NO_2)_3$, using a Bloembergen-Purcell-Pound type of apparatus designed for nuclear magnetic resonance experiments.[1] The modulation frequency used was 30 cycles/sec. The signal was sufficiently strong to be very easily observable on an oscilloscope, although the line width was obtained by means of slope measurements using a one-cycle wide amplifier. A solenoid operating from storage batteries supplied a steady field of sufficient homogeneity.

To our knowledge this is the lowest field strength at which paramagnetic resonance has been observed. Indications are that the line can be detected readily at even lower fields, thus providing a means of extending the range of precision magnetic field measurements provided by the nuclear resonance technique down to such fields. The nuclear resonance signal becomes too weak at low fields to be easily detectable. By inserting a paramagnetic material in place of one involving the use of nuclear magnetism, an enormous increase of signal to noise is obtained.

The observed line width at 29.5 Mc, as measured by the separation between the points of extreme slope of the absorption signal, was 1.4 ± 0.1 gauss. This is not necessarily the same as the width measured at the half-maximum absorption points, since the strong exchange narrowing occurring in the material tends to raise the extreme slope points above the half-maximum points. At microwave frequencies using the latter points a line width roughly double this has been reported.[2,3]

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[2] Holden, Kittel, Merritt, and Yager, Phys. Rev. **77**, 147 (1950).
[3] Townes and Turkevich, Phys. Rev. **77**, 148 (1950).

The Qualitative Similarity of Origin of the Main Cosmic Radiation and of Showers

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In a recent communication Cocconi[1] raises the question whether or not the total continuous cosmic radiation and the extensive atmospheric showers occurring in it are produced by entirely equivalent processes.

This problem has occupied our attention for many years, and, from different measurements, we have concluded that when a meson comes down there is a chance of from 40 to 100 percent that a coherent meson will be found in the neighborhood.[2] This was found by measuring the coincidences of a penetrating particle passing through a surface of size 6×6 cm, with another particle passing through another surface of 6×6 cm at three different distances from the first, of 9, 14, and 21 cm. From the exponential decrease in the coincidence rate with distance, we were able to find the total flux of soft and of penetrating particles around the direction of the primary particles. The ratio of the soft (which we take to be decay electrons) to the penetrating particles was found to lie between 0.09 and 0.12. In two independent sets of measurements the occurrence of coherent penetrating particles was found to be 40 to 100 percent, respectively, so that we concluded that generally at least one coherent meson, or an electron resulting from the decay of one, comes down with every meson.

In another experiment we took two sets of 3 counter boxes, with a sensitive surface of 140 cm^2 per set. The number of coherent particles registered at three distances enabled us to conclude that the distribution of the particles around each of the sets decreased exponentially with the distance to that set. We were able to compute the total number of particles coming down simultaneously with the particle in the first set. This was 202 per minute, while the number of particles counted in the first set was 260, so that we found that in 80 percent of the cases there must have been a coherent meson in the neighborhood.[3]

We must realize that in most cases the energy of the incident proton is not very large, so that the multiplicity of production is small. Moreover, since this production occurs at high altitudes, the number of coherent mesons which can be found in the lower parts of the atmosphere will be small, in general, and the number of secondaries accompanying the penetrating meson will be small also in the very extensive showers. But if two conditions are realized, (1) that the proton producing the mesons (which in their turn produce secondaries) has a high energy, and (2) that the position of the primary collision happens to lie in the lower atmosphere, the mesons and their secondaries will then be observed as a high concentration of particles, that is, as a shower. That the large showers are produced at low levels is confirmed by the fact that the barometric coefficient[3] is about 14 percent per cm Hg. Qualitatively, the original process will be the same in the case of the continuous radiation and of the showers.

[1] G. Cocconi, Phys. Rev. **79**, 1006 (1950).
[2] J. Clay, Physica **13**, 433 (1947).
[3] J. Clay, Physica **16**, 278 (1949).