bellows. When the serrations are sufficiently marked, one layer after another in succession, beginning with the uppermost, separates itself from the lower part of the image, becomes narrower horizontally and much thinner vertically, turns green or blue, often at least at the pointed extremities first, and disappears. In the last two or three years I have repeatedly witnessed this phenomenon, obtaining all the way from two to six green and blue flashes. In the one case in which six colored flashes were certainly observed, the serrations were quite deep, the sun's disk was not very red, and all or nearly all the flashes were distinctly *blue*. The last layer at disappearance became whitish, as the upper edge of the image often does when the sun sets red. When the serrations are not deep and the layers are thin, the layers may shrink horizontally without becoming distinctly separated from the lower image, the pointed and colored ends moving inward slowly until the layer disappears.

In one very interesting case the sunset over the ocean red and oval (as usual becoming flatter beneath), but at first without noticeable serrations. As the sunset progressed the image became sharply divided by a horizontal line, ending in somewhat deep and sharp depressions. Below the line the image was distinctly and uniformly yellowish green, above the line uniformly reddish, or reddish yellow, the redder portion having an area perhaps three-quarters that of the whole image. As the sunset progressed further, the color again became homogeneous and red and the depressions disappeared, while the image took on the form of a rectangle capped by an isosceles triangle with somewhat rounded top. The top of the triangle now came off, turned blue, and disappeared. Then in between the point at which this disappearance occurred and the flattening disk another blue flash appeared, where nothing had been visible before. The image then became more and more flattened, and thinner vertically, without changing appreciably in horizontal width, and disappeared red (as the image often does).

Most of these observations were made with one inch achromatic binoculars magnifying about six diameters.

S. J. Barnett

University of California at Los Angeles and
California Institute of Technology,
May 31, 1934.

The Magnetic Moment of the Neutron

Our application[1] of the g-formula to the spin and orbit of a neutron in the nucleus is only partially correct, although the result (neutron $=-0.6$ magneton) is not affected. But the coordination of l and j in the tables is to be changed. The correct theory together with important generalizations is given meantime independently by I. Tamm and S. Altschuler.[2] They find the value -0.5 similar to ours. We do not agree with the analysis of H. Schueler[3] who gives the neutron -1.65 magnetons.

Alfred Landé
D. R. Inglis

Ohio State University,
June 7, 1934.

[1] Inglis and Landé, Phys. Rev. **45**, 842 (1934).
[2] Tamm and Altschuler, Comptes Rendus de l'Acad. des Sciences de l'USSR **1**, 458 (1934).
[3] Schueler, Zeits. f. Physik **88**, 323 (1934).

Remarks on Super-Novae and Cosmic Rays

We have recently called attention to a remarkable type of giant novae.[1] As the subject of super-novae is probably very unfamiliar we give here a few more details which are not contained in our original articles.

1. Distribution of super-novae

In our calculations we made use of the assumption that on the average one super-nova appears in each galaxy every thousand years. This estimate is based on the occurrence of super-novae in the following galaxies,

Our own galaxy	in 1572
Andromeda	1885
Messier 101	1907

These three systems are located within a sphere of radius 12×10^5 light years.

In the Virgo cluster, which contains about 500 nebulae, six super-novae were found on plates taken during the last thirty years. As a curiosity we mention that in N.G.C. 4321, which is a member of Virgo, two super-novae have appeared in 1901 and 1914, respectively.

In the same interval of 30 years six additional super-novae were found in isolated nebulae.

We wish to emphasize that all of these finds are chance finds since a systematic search for super-novae has been organized only recently.

From the estimate of one super-nova per galaxy per thousand years it follows that 10^7 super-novae appear per year in the 10^{10} nebulae which are contained in a sphere of 2×10^9 years radius (critical distance derived from the red shift of nebulae). If cosmic rays come from super-novae their intensity in points far away from any individual super-nova will be essentially independent of time.

2. Comparison with the lifetime of stars

The lifetime of stars is supposed to be of the order of at least 10^{12} years. A nebula contains about 10^9 stars. These estimates, combined with the frequency of occurrence of one super-nova per galaxy per 10^3 years suggest that the super-nova process might occur to every star once in its lifetime, marking perhaps the cessation of its existence as an ordinary star. We realize that this suggestion is highly speculative in view of the possibility that the frequency of occurrence of super-novae may depend on time and in view

[1] W. Baade and F. Zwicky, Proc. Nat. Acad. Sci. May, 1934.