as opposed to the reflex nature of the primary response.

This method has made it possible to sort out the various occurrences in the seemingly very rapid responses following the gunshot. In the infant it is possible to differentiate between the primary startle pattern and the Moro reflex. In the adult we can separate the primary reflex response from the "voluntary jumping," etc. In patients showing Parkinsonian tremor the ultra-rapid photography shows a very brief cessation of the tremor after the gunshot, during which period the elements of the startle pattern appear, followed by resumption of the tremor.

While much can be done, as we have shown, with the relatively small magnification provided by a camera speed of 64 exposures per second, there is much more to be obtained at higher camera speeds. We have now begun to work with cameras capable of running as fast as 3,000 exposures per second. At present, we have results at speeds of 700 and 1,500 exposures per second. We have applied these speeds to the problem of voluntary facilitation of the reflex startle response. With the naked eye, it is impossible to separate the original response from the voluntary facilitation. At both 700 and 1,500 exposures per second, the two can be clearly separated. The primary startle pattern appears first; there is an appreciable interval; and then the "facilitation" appears as a separate response. The uses of this technique in revealing the interrelations of voluntary and involuntary response are evident. A feature of these special cameras is a timing dial included in the photographic field which may be read directly to 0.002 seconds.

The magnification of time in this fashion raises interesting perceptual problems. The dimension of time is an important determinant of the "form quality" or "gestalt" of any experience. The distortion of this one dimension may be sufficient to change the quality of the perceptual pattern. Thus, the facial elements of the startle pattern at normal speed, four times slower than normal, and fifty times slower than normal, are three qualitatively different expressions, their identity evident only if one knows the background of conditions under which the pictures were taken. The first is a "jerk," the second resembles a "hiccup," and the third a stretchy yawn. All three involve the same response with only the speed of presentation changed. Thus, the technique of temporal magnification offers a new approach to the study of time as a factor in perceptual organization.

Carney Landis

N. Y. Psychiatric Institute

W. A. Hunt

Connecticut College

CELL INCLUSIONS IN AZOTOBACTER CHROOCOCCUM BEJ.

In a recent issue of this journal[1] I. M. Lewis, discussing the work of Jones, Löhnis and Smith, Mencl, Prazmowski and of Schmidt on the nature of the stainable granules in the cells of *Azotobacter chroococcum*, writes: "There is no indication that any of the other workers performed microchemical or solubility tests to determine whether the stainable bodies are living entities of the cell or lifeless cell inclusions which function as reserve food." He further states that his own investigations showed these to be composed of volutin.

Solely in the interest of truth and as a corroboration of the results reported by Lewis, it may be of interest here to mention a publication of the present author[2] in which, after a long series of microchemical and solubility studies, the writer concludes that "the granulations take the basic dyes and are constituted neither of fats nor glycogen, starch nor chromatine. They seem to be of a metachromatic nature." . . . and that "there is no doubt that metachromatic or, as Meyer terms them, volutine granules were found."

The reserve nature of these bodies was further demonstrated by the preesnt writer[3] by a study of their autophagy.

Augusto Bonazzi

Ministerio de Agricultura y Cría
Caracas, Venezuela

SCIENTIFIC BOOKS

STATISTICAL MECHANICS

Statistical Mechanics. By R. H. Fowler. 864 pp. Cambridge: at the University Press. New York: The Macmillan Company. 1937. $14.00.

The first edition of this monumental work, which appeared in 1929 and which we reviewed in this journal,[1] is already a classic in the literature of theoretical physics. So it will suffice to describe the respects in which the second edition differs from the first, both in the presentation of general principles and in the applications to particular problems. The increase in size is immediately apparent. We have always thought the author must have been almost a superman to write a volume as comprehensive as the first edition on such difficult subject-matter. Now, however, the number of pages has grown from 570 to 864, and of numbered equations from 1,607 to 2,344!

[1] J. H. Van Vleck, Science, 70: 41, 1929.

[1] Science, n. s., 85: 16, 1937.
[2] *Jour. Agr. Res.*, 4: 225–239, 1915.
[3] *Jour. Bacter.*, 6: 331–359, 1921.

As regards theoretical principles, the general method, based on contour integration and steepest descents, is the same as before, the main difference being that quantum statistics are presented from the very first, whereas until the last chapter the earlier edition used the quantal adaptation of Boltzmann statistics. For many problems, it is immaterial which version is used, but the new form is necessary, for instance, in the discussion of conducting metals, where the exclusion principle plays such an important rôle, or of chemical constants, which may involve the enumeration of nuclear spins.

In the applications, the subject-matter which is treated is distinctly more comprehensive than in the first edition. The electric and especially the magnetic susceptibilities of solids are now discussed in considerable detail, in the author's usual terse and accurate style. The reviewer has detected only one error, *viz.*, the incorrect statement on p. 480 that the apparent number of electrons in nickel is lower above the Curie point than at saturation. There is a very illuminating discussion of the conditions under which the local field is E or is instead $E + 4\pi P/3$. However, it should have been more succinctly emphasized that in polar media the statistical fluctuations may limit the rigor and applicability of the local field method. Almost a hundred new pages have been inserted on the electron theory of metals, thermionics and metallic conduction, including the rather spectacular recent work on "energy bands" and on the influence of impurities in semiconductors. An interesting section is added at the very end of the book on the timely subject of the production of extremely low temperatures by the magnetic method. The presentation of the applications covered in the earlier edition, notably astrophysical problems and the equations of state of gases and solids, has been thoroughly modernized. One usually thinks of the most striking developments of the last decade in extra-nuclear physics as in theory rather than experiment, but actually a very high percentage of the relevant experimental measurements quoted in the volume are subsequent to the first edition. On the whole, the documentation of the literature is quite complete, although occasional oversights may be noted, *e.g.*, Roebuck's determination of the second virial coefficient of helium by the porous plug experiment, as calculated by Whitelaw in *Physica*. The rapid tempo at which the material treated in the volume has been, and still is, developing both on the theoretical and experimental sides shows that even the portion of physics which is not concerned with either cosmic rays or nuclear disintegration is far from being a dead subject!

J. H. VAN VLECK

METEOROLOGY

Manual of Meteorology, Volume II, second edition. By SIR NAPIER SHAW, xlviii + 472 pp. 1936. Cambridge: at the University Press. New York: The Macmillan Company, $10.00.

THE first edition of the second volume of Shaw's great four-tome manual—the volume of facts without explanations—is far too valuable to discard, but this second edition contains so much additional material that no one who tries to keep well informed about the circulation of the atmosphere, normal, seasonal and transitory, can afford to be without it.

The book begins with discussions of a number of technical terms, so clear and detailed as to merit reading and rereading by physicists as well as meteorologists. This is followed by an 8-page discussion of units and measurement that gives much valuable and even some surprising information.

This finishes the Roman-numbered pages, a valuable treatise apart even from the rest of the volume. The first six chapters of the book proper (there are ten in all) cover, in order, solar and terrestrial radiation; distribution of land, ocean, ice, volcanoes, earthquakes, thunderstorms, magnetic lines, etc.; composition of the atmosphere; temperature of the surface air the world over and through the seasons; clouds and rainfall; pressure and winds. Much of this information is given in scores of full-page hemispherical charts.

Chapter 7, which lists a great number of reputed weather cycles and correlations, must have cost the author more labor to compile than any other in the entire manual. It deals with prodigious labors that essentially came to naught, for cycle study long has been, as presumably it long will continue to be, the fatal candle for the meteorological moth.

In Chapter 8 are discussed the several transitory variations of pressure, especially the tropical cyclone, the tornado, waterspouts and line squalls. The first portion of Chapter 9 consists of accounts of the earlier ideas of the structure of the mid-latitude cyclone, and the rest to an explanation of our present notions of this structure based on air-mass analysis. Chapter 10, the last in the book, and bringing it up to date, is a meteorological potpourri consisting of a number of interesting discussions of rather disconnected matters —the solar constant, duration of snow cover, arctic ice, the upper atmosphere, dust storms, weather in Greenland, etc. This is followed by an extensive and conveniently arranged bibliography, and that in turn by a 20-page, double-column index.

Here and there throughout the volume are delightful passages that "sample" pretty nearly pure Shaw, rather than mere meteorology, but they are none the less informative for all that and twice as interesting.

W. J. HUMPHREYS