unusual meaning was assigned to the term "state." Having in mind the indeterminacies of atomic systems, the author aimed by this word at a characteristic which is at once but little affected by the uncertainties and is permanent in time (something like a generalization of the "stationary states"). It must be admitted that such a concept is fundamental, and attractive as a basis of quantum mechanics. But to use for it the word "state" is conducive to constant misunderstandings. It was mainly due to these two features that the first part of the old edition made difficult reading, overtaxing the powers of abstraction of the less experienced student and making the book unsuitable as a classroom text.

Both flaws are completely eliminated from the second edition. The author does not forget for a moment to stress the experimental point of view and lives up in his exposition to the principle stated by him on page 5: "Only questions about the results of experiments have real significance and it is only such questions that theoretical physicists consider." The text is rewritten with a view of attributing to the word *"state"* its more common sense as the quantum analogue to the numerical values, at a given moment, of the coordinates and momenta of a classical dynamical system. (While an *"observable"* is the analogue to the instantaneous numerical value of a classical variable or of a function of the coordinates and momenta). This meaning of the word "state" may be less fundamental for the quantum theory than that used in the first edition, but its didactic superiority is unquestionable. It manifests itself in the fact that its use quite naturally divides the treatment into two parts—"part (I), dealing with relations and laws of nature governing the state of affairs in an atomic system at one instant of time, and part (II), dealing with the connexion between the state of affairs at one instant of time and at a slightly later instant." The content of the first part (Chapters II to V) is, from the mathematical point of view, the symbolic algebra of transformations and, from the physical, the statement of the limitations of our power of observation of small systems. The second part (Chapters VI to XIII) is, in both respects, the analogue of the equations of motion of classical mechanics and contains all the special applications.

This change in the direction of making the exposition less abstract does not sacrifice, but rather enhances, its logical rigor and mathematical elegance. It makes the book clear and simple in all its parts, and there is no longer any reason why it should not prove of excellent service as a text in advanced courses. In fact, the author's ability "to keep the physics to the forefront" is an important pedagogical advantage. Paradoxically, it takes a great master of mathematics to give a truly physical presentation, and the formalism developed by Dirac is particularly adapted to keep the mathematical apparatus ancillary to the physical content.

The subject-matter is not materially changed in the new edition. One of the most important events, since the appearance of the old one, was the discovery of the positron. It was a triumph of Dirac's theory of the electron because it supplied a physical interpretation of the negative energy states. Questions relating to the formation of electron-positron pairs are in the foreground of current theoretical investigations. The author must have felt, however, that these theories have not yet crystallized into a consistent system and are not secure enough to be included in a treatise of the character of a text- and hand-book: only one brief section is devoted to the positron. On the other hand, there is attached to it a new chapter on the electromagnetic field theory which has attained in the last years a formally satisfactory character as a complete analogue to classical electrodynamics (although some deeper problems connected with the structure of the electron remain unresolved). A valuable new feature is an "Index of Definitions," which was lacking in the first edition.

PAUL S. EPSTEIN

GARDEN PLANTS

The Genetics of Garden Plants. By M. CRANE and W. J. C. LAWRENCE. Foreword by Sir Daniel Hall. Pp. xxi, 236. 53 figures, 42 tables. Macmillan and Company, London, 1934. 10s. 6d.

THE authors state in their preface that the object of this book is twofold: first, to give an introduction to the essential principles of genetics and cytology; and secondly, to give an account of recent results in relation to horticulture.

The first three chapters are devoted to a brief treatment of the genetics and cytology of diploid and polyploid plants. The next chapter deals with flowering and ornamental plants. Limitations of space preclude a discussion of all the work which has been done, so the authors confine their attention chiefly to those plants which have been most intensively investigated. The sweet pea, garden stock, Chinese primrose, dahlia and snapdragon are considered and the chapter closes with brief comment on a number of interspecific hybrids. The present reviewer would have welcomed a more detailed account of the work which Baur and his associates have carried on with *Antirrhinum,* but obviously in a general text covering such a wide field it is impossible to discuss any particular plant at great length.

The tomato, garden pea, radish, lettuce, onion, beet, cucumber and potato are among the vegetable and salad plants discussed. A long list of fruits is dealt

with, but even so a considerable number, including the citrus fruits, have been omitted. In the opinion of this reviewer the value of the book would have been considerably enhanced if it had been restricted in scope to the flowering and ornamental plants, or the vegetable and salad plants, or the fruits, thus permitting a more comprehensive review of a relatively limited field.

The chapters dealing with incompatibility and sterility are of great interest to both the geneticist and practical plant breeder. They show clearly the important progress which has been made in this field in recent years.

The final chapter outlines the modes of origin of new and improved forms of garden plants. A number of interesting cases of constant hybrids are given. Among other problems brief mention of breeding for disease resistance is included. This subject is receiving increasing attention and represents one of the most promising fields open to the plant breeder at the present time, so it might well have been given greater emphasis.

The book includes a glossary, bibliography and index. It is written in a clear and interesting way, and will doubtless be favorably received by both geneticists and plant breeders.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

SAND AND WATER PARADOX

AT the March meeting of the Central Ohio Physics Club, Dr. G. E. Owen presented a startling experiment which apparently has not been completely explained. The apparatus consisted of a rubber bulb about 50 cc capacity with a glass tube, in which one could observe the water level at about half the length of the tube. When the bulb was squeezed, instead of an expected rise in level, the water was rapidly drawn into the bulb!

If the position of the level in the tube is to be considered as the indication of the pressure within the rubber bulb, then we have an interesting working model for that hypothetical part of van der Waals' equation where, indeed, a decrease in volume causes also a decrease in pressure.

The construction of the apparatus is made clear in Fig. 1, a, in its vertical cross section. The rubber bulb is tightly packed with sand up to the lower end of the glass tube, which is flared. A silk bolting cloth is stretched across the mouth of the tube to prevent sand from entering into the tube. Under ordinary conditions the grains of sand are so packed as to occupy the state of lowest potential energy which leaves the least volume between them. When the bulb is compressed, the spheres separate and the increased interstices draw in the water from the vertical tube. In a two-dimensional idealized diagram, Fig. 1, b, the

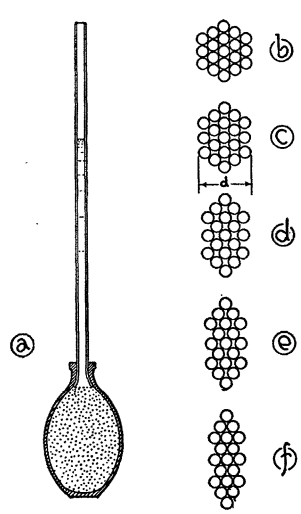

FIG. 1.

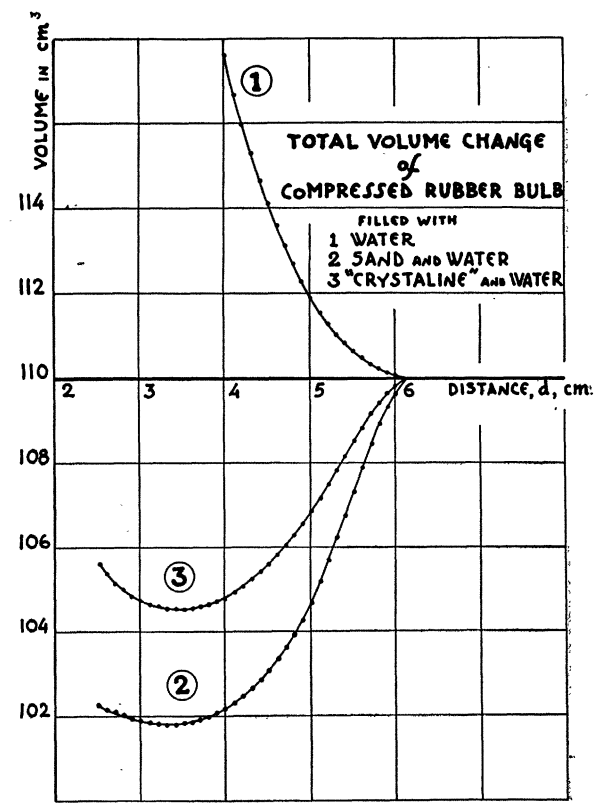

FIG. 2.