of the principles of Colon Classification and its application to advantage to the vast stores of books on Indian civilization, philosophy and culture, especially of the South.

K. KASTHURI RANGACHAR.

Plant Breeding Technique in Recent Years. By R. H. Richharia. (The Bangalore Press, Bangalore City), 1939. Pp. 73. Price Rs. 2-8.

The publication of this book has removed the long-felt want of amateur plant breeders and persons interested in the science of plant breeding, who have neither the necessary background for understanding the subject nor the proper opportunities to learn the modern technique. It will also be of great use to students of Agriculture and Botany.

The author has divided the book into fourteen chapters describing the different aspects of plant breeding and vividly putting forth the importance of cytological investigations in understanding the problems of plant breeding and genetics, especially by the non-Mendelian methods. Chapters on polyploidy, haploidy, decapitation and effect of temperatures, chemicals and radiations are particularly intersting.

Numerous diagrams and illustrations make the reading of the book more interesting. The get-up of the book and printing are excellent.

R. J. K.

From J. J. to G. P.

Theory and Practice of Electron Diffraction. By G. P. Thomson and W. Cochrane. (Macmillan & Co., Ltd., London), 1939. Pp. xii + 334. Price 18*sh*.

SIR J. J. THOMSON, while describing the discovery of the electron writes in his book *Recollections and Reflections*: "At first there were very few who believed in the existence of these bodies smaller than atoms. I was even told long afterwards by a distinguished physicist who had been present at my lecture at the Royal Institution that he thought I had been 'pulling their legs'." Professor G. P. Thomson when he first published in 1927, photographs obtained by sending a beam of homogeneous cathode rays through a very thin film of collodion, could also have been accused of leg pulling. The average physicist then was either unaware of de Broglie's theory or he did not suspect that there would be such a strong coupling between the probability waves and atoms, which would permit them to form diffraction patterns of appreciable intensity. The fundamentals on which this significant achievement has been based are now recounted in this book.

The first chapter deals with the fundamental properties of wave motion and de Broglie's wavemechanics. The theory has been written from the point of view of an experimental physicist, and the physical significance of various mathematical operations has been cleverly pointed out. Thus about the Huygens' construction the authors write that it implies nothing not already given by geometrical optics. They define group velocity as the velocity with which a peculiarity associated with the group, such as a maximum of amplitude will advance.

De Broglie started from the idea that Einstein's equation $E = h\nu$ represents a fundamental relation between energy and frequency. By the theory of relativity a particle of resting mass m_0 has associated with it energy $m_0 c^2$, and should therefore have an inherent frequency $\nu_0 = m_0 c^2/h$. De Broglie regarded this as the frequency of a pulsation in the space surrounding the particle. The wave velocity is $V = c^2/u$ and the corresponding wave-length is $\lambda = h/mu$. De Broglie's idea that the waves act as a guide for the particles and determine their motion necessitates that the ordinary Newtonian mechanics, or rather their relativistic generalisation should be replaced by laws which involve the conception of waves. When experiments are carried out to verify de Broglie's law, it would appear that the theory holds up to as high as a million volts, to better than 5 per cent. This result is important because the theory given by de Broglie is incomplete as it takes no account of the spin of the electron; but the terms involving spin should be expected to become important for speeds near the velocity of light. Thus the equation

$$\nabla^2\psi + \frac{8\pi^2 m_0}{h^2}(E - F)\,\psi = 0$$

is incomplete and it is therefore interesting that it still gives the right value for the wave-length.

The readers are next treated to an account of Ewald's reciprocal lattice, and

how the pattern obtained on a distant screen will be the projection of the points of the reciprocal lattice lying on Ewald's sphere. It is only in exceptional cases that a point will lie actually on the sphere, but the rigorous conditions are relaxed in various ways. The wave-length of the electrons will not be exactly fixed, the real crystals have imperfections, and these imperfections assume enormous importance as the angles of diffraction are very small. This enables the authors to explain such phenomena as the Kikuchi patterns, the so-called forbidden spectra and the subsidiary diffraction maxima observed by Finch and Wilman.

The intensity of the diffracted beams depends not on the atom form factor only but also on the structure factor. The most important point that appears is the very large values of the scattering of electronic waves as compared with X-rays.

There are three chapters which will be of great use to experimental physicists interested in electron diffraction. The effect of the refractive index of the specimen is described and it is pointed out that such an effect should be considered only in the case of reflection experiments from reasonably smooth surfaces. The formation of Kikuchi lines, their changes of intensity and the envelopes of Kikuchi lines have received their due share. The effect of temperature and the size of the crystals on the dimensions of the lattice has been pointed out. But the description of the principal types of diffraction patterns observed and the way they should be interpreted is so important that a beginner would be well advised to master it before he starts taking electron diffraction pictures. It is interesting to note that the minimum thickness to give a detectable pattern with 30,000 volts electrons is of the order of 10–12Å; and it is this property which makes the electrons indispensable for surface investigations. The authors point out that part of the electron diffraction technique is ordinary vacuum practice. They also describe the various types of electron diffraction cameras which have been evolved, how the specimens should be prepared, and photographic patterns measured.

In a limited number of special problems, a large proportion of the information has been obtained by the application of electron diffraction methods. The problems thus treated are the measurement of inner potential, the study of the growth of crystals, the nature of oxides and the polished layer and the structure of oils, greases and lubricants. There is also a wider field in which the method of electron diffraction can be used. The authors after describing the technique and the theory of electron diffraction by gas molecules point out that the interpretation of electron diffraction patterns from gas molecules is not so straightforward as in the case of crystalline solids. Generally speaking, a trial and error method must be adopted; a molecular model of definite dimensions has to be found such that the calculated distribution of intensity agrees with the experimental results. This is illustrated by applying the method to a benzene molecule, and pointing out that in such a case it is possible to infer that the C – C bond 'resonates' about equally between a single bond and a double bond. Lastly the slow electrons have an advantage over fast electrons in that they are more sensitive to absorbed gas.

The book closes with a discussion of the present limitations of the theory. Thus a full description is given of Bethe's dynamical treatment of the diffraction of electrons. And although the dynamical theory is based on sounder foundations than the kinematical, it has not been able to claim more successes than its rival—the kinematical theory—which has the advantage of simplicity. Darwin's version of the theory of the spinning electron is given and it has been pointed out that the detection of any effect due to magnetic moment or polarisation is not an easy matter. All theoretical physicists except Mott find no appreciable effects due to polarisation, while Mott finds that nuclear scattering ought to produce an appreciable asymmetry of the scattered electron beam if certain conditions are fulfilled. The experimental results, however, definitely prove that Mott's theory is not correct, as applied to the scattering of electrons by thin films of gold.

The treatment of the subject is throughout lucid and *anschaulich*. The book combines the unique qualities of simplicity and authority and as such is likely to prove itself the bible of electron-diffractionists or should we say interfractionists. But could we expect anything else from a book that comes straight from the pen of Prof. G. P. who is the world-authority on the subject of electron diffraction?

K. R. Dixit.