

understood by such persons, at least with readiness.

Eighteen pages are devoted to vegetative reproduction with a discussion of cuttings, runners, bulbs, tubers, grafting, etc., in the higher plants, and of conidia, swarm-spores and fission in the fungi and algæ. Eighty-seven pages treat of sexual reproduction. The author traces the history of the knowledge of sexuality in plants from the Greek philosophers down to its demonstration by Camerarius, confirmation by Kohlreuter, discovery of the pollen-tube by Amici, observation of sexuality in cryptogams by Hofmeister, Thuret and Pringsheim, and the more recent investigations showing the part played by the nuclei, chromosomes, synapsis, etc., thus bringing the subject down to this year. After this historical and general discussion the different groups of plants are taken up, showing the increasing complexity of the sexual process from the union of two equal cells up to the complicated processes in the higher fungi and algæ, the alternation of generation and development of heterospory in the Archegoniata and the double fertilization in the Angiosperms. Under the caption General Questions are taken up sexual affinity, hybrids, polyspermy, parthenogenesis, parthenocarp, apogamy, apospory, merogony and determination of sex. The final considerations take up the theory of fertilization and the theory of sex, the various views being presented in an unbiased manner as well as the objections to them.

Although professedly designed for those who are not specialists this book should prove valuable for both students and teachers. The references to literature, both old and very recent, although with no pretence to completeness, yet give the most important contributions bearing on the subject. The figures are, for the most part, very good.

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#### SOCIETIES AND ACADEMIES.

##### THE AMERICAN PHILOSOPHICAL SOCIETY.

A STATED meeting was held on Friday evening, November 2, 1906, at 8 o'clock. The following papers were read:

DR. ALFRED C. HADDON, F.R.S., University Lecturer in Ethnology, Cambridge, Eng.: 'The Decorative Art of British New Guinea.' (Illustrated.)

DR. JOHN W. HARSHBERGER: 'A Grass-killing Slime Mould.'

#### DISCUSSION AND CORRESPONDENCE.

##### SOME POINTS IN TEACHING CRYSTALLOGRAPHY.

THE writer wishes to call attention to and invite discussion of the following points in the teaching of crystallography as a part of the work in elementary mineralogy.

The best classification even for beginning students is that of the thirty-two crystal classes, based upon symmetry. All ideas of hemihedrism should be dropped as there is no structural connection between the whole and partial forms. The name of the class is the name of the general form. Groth's set of names is the best, but his names for the isometric classes may be replaced by the terms, tetartoidal, gyroidal, diploidal, hextetrahedral and hexoctahedral for classes twenty-eight to thirty-two.

A division of crystals into seven systems is preferable to that of six. Crystals with an axis of three-fold symmetry naturally form one system and those with an axis of six-fold symmetry another system. And this is true whether the three axes of Miller or the four axes of Bravais are used. The writer prefers to treat the orthorhombic system, one of moderate symmetry, first.

It is believed that von Fedorow's method of naming forms (adopted by Groth in his 'Physikalische Kristallographie') is the only logical one. The name of a form depends upon its shape and is independent of how it cuts the axes of reference. A pinacoid consists of two parallel faces whether its symbol is 100, *h0l*, *hkl* or what not. A pyramid is three or more like faces meeting in a point and a bipyramid is two such solids placed base to base. Instead of using a name for the particular form, *e. g.*, pinacoid of the first kind, as von Fedorow does, we may simply give the name of the form together with the symbol, *e. g.*, pinacoid (100).

There is weighty argument in using the Miller symbols even with beginners in crystallography. In elementary work only type symbols are used and for these the Miller system is as easy as any. One only has to replace one index of the symbol  $hkl$  by a zero when a face is parallel to an axis. When it comes to a question of actual symbols the Miller indices of course take precedence over the Weiss. If one learns Miller from the start there is never the necessity of translating back and forth from Weiss, which is a waste of energy. And lastly the Miller is the only universal system.

The fact that the axial ratios are irrational and that the indices are rational is a thing that always gives many students trouble. Thus most students can not see why the symbol 111 does not represent a face that cuts the three axes  $a$ ,  $b$  and  $c$  at equal lengths. The writer has used a homely illustration that usually makes it clearer at least. Take two cities, laid out in different ways. A pedestrian on inquiring about a certain building in either place might be told: Go two blocks north, three blocks east. Yet the actual distance he had to walk in the two cities would be different, for the lengths of the blocks are different. These distances are on record and correspond to the axial ratios. Yet the pedestrian is not concerned directly with them. The two blocks and three blocks correspond to the indices.

In order to really understand some of the essential points of crystallography the student must devote some time to crystal measurement, calculation and drawing. And without something of the sort, the time given to crystallography may almost be a waste of time unless it is taken up at some future time. To accomplish this in the limited time available in a general course in mineralogy is difficult. The writer has had partial success with the following method. Selected crystals or wooden models preferably orthorhombic with 110,  $hk0$ , 011 and one or more of 100, 010 or 001 are chosen.

- (1) Free-hand sketch of the crystal.
- (2) Number faces and indicate zones.

(3) Measurement of interfacial angles with the contact goniometer.

(4) Stereographic projection on sheets devised by Penfield.

(5) Graphic determination of  $a$  and  $c$  from 110 and 011.

(6) Graphic determination of indices  $hk0$ .

(7) Orthographic projection (plan and elevation) from stereographic.

Taken up in this manner the work is not at all difficult for the drawing of zone circles is not necessary in the stereographic projection and the tedious clinographic projection is replaced by the orthographic. Yet the student appreciates something of the meaning of axial ratios and indices and is ready, if need be, to take up more advanced work.

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#### SPECIAL ARTICLES.

##### IS THERE DETERMINATE VARIATION?

HOWEVER willingly we incorporate in our general conception and knowledge of variation the special conception of mutations (in the de Vriesian sense) and however implicitly we accept de Vries's primrose species by mutation, we must none the less hold clearly in mind that the kind of variation still most familiar to us all is that kind variously called individual, fluctuating, continuous or Darwinian variation, and we must not for a moment, because some species may have been shown to have arisen in some other way, deem ourselves absolved from the responsibility of further testing the Darwinian assumption of species-forming by the natural selection of individuals possessing advantageous slight variations.

If new species arise by virtue of a cumulation or progressive increase of small fluctuating variations in continuous series, they can apparently only do so through (a) natural selection, or (b) determinate or orthogenetic variation. The principal argument for a belief in determinate variation so far advanced seems to be that natural selection is unable to make use of fluctuating variation because (1) this variation is too small and useless to be a handle for life and death selectivity, and be-