vestigation resolves itself into a study of coloration in the genus." The conditions which make for variation in the different species are well indicated, as the author points out that, even where the inmates of a single nest are examined, the following points have to be considered :—First, that two or three females may work together for the good of one community, and may be very differently coloured; secondly, that each may be fertilised by several males, which again may be differently coloured; thirdly, that intruders from other nests may be present as they "are not always so certainly driven away from strange nests as has been affirmed for other social Hymenoptera."

In these circumstances, the attempt to distinguish the species by colour characters seems to be almost hopeless—a point, however, which seems to the present writer to have been overlooked is the possibility of the presence of unobserved plastic characters which might serve as better and more satisfactory guides to classification. That such characters exist among the palæarctic species has been demonstrated by F. F. Kohl in *Ann. K.K. Naturh. Hofmuseum*, Wien, xiii., heft i., pp. 87–90, taf. iii., who shows that five forms of the males can be easily separated by well-defined characters in the form of the clypeus and genæ, the grooves of the face, and the shapes of the subapical joints of the antennæ, and although their respective females and workers have not been satisfactorily identified, it is not improbable that careful investigation may yet disclose characters to associate the sexes of the different species together; as also it is quite probable that all the species would vary in colour in more or less parallel directions—any investigation into the distribution of the species, unless conducted with special reference to these characters of the males, would be very liable to lead to wrong conclusions. One conclusion especially to which one would like to apply the male character test is summed up in the following words :—"It is hardly probable that we have in *P. variatus* a primitive species which has differentiated in two directions, but, as we shall see from the study of the geographical distribution of the species, aurifer and pallipes are two originally distinct species which, from the course of their migration northwards, have come together in the Mississippi valley, and by their commingling produced a species having, in some measure, the characters of both." These remarks are made with no wish to depreciate, even if it were possible, this very careful attempt to investigate a most difficult problem, but merely to point out that there are characters in our Palæarctic species of Polistes which might be well looked for in those of the other hemisphere.

## THE CLEAVAGE OF SLATES.

THE memoir described below[1] contains an account of experiments undertaken to test the author's theory, propounded some years ago, of the cause of the cleavage property in slates. Dr. Becker's theory, substantially the same as that put forward earlier by the Rev. O. Fisher, is that cleavage-planes are planes of maximum tangential strain, or in other words shear-planes. This is opposed to the theory of Sharpe (or, as we might say, of Sharpe and Sorby), which makes the cleavage-planes perpendicular to the maximum compression. The author has misunderstood Dr. Sorby's position, having apparently overlooked the earlier papers of that writer. The question whether heterogeneity in the rock is necessary for the production of cleavage seems to be beside the mark, since all rocks (other than glasses) are heterogeneous in this sense. Both Tyndall's wax and Dr. Becker's ceresin, being crystalline bodies, are heterogeneous, and their behaviour must depend on the orientation of the minute component crystals.

The experiments described were carried out with ceresin, a substance of the paraffin series, and some also with clay. These were submitted in one series of tests to simple compression, and in another series to shearing by means of a machine devised for the purpose. In the small masses dealt with the strains developed vary greatly from point to point, and the resulting structure is of a complex kind. We must confess that we are not convinced that the effects observed are such as to be rightly described as cleavage—they have rather the character of fractures, depending on the application of the forces which produce them, as well as on the intimate structure of the material.

It is unfortunate that no attempt is made to collate the results of the experiments with actual examples of cleaved rocks. As the author remarks, the position of the strain-ellipsoid affords a crucial test. On the Sharpe-Sorby theory the principal diametral plane of the ellipsoid must coincide with the cleavage-plane; on Dr. Becker's hypothesis it should be inclined at some angle of less than 45°. Now there are many slates in which the strain-ellipsoid is actually presented in deformed spherical concretions or colour-spots. The "birdseye" slate of Westmorland and the green-spotted purple slates of Llanberis are examples familiar to every English geologist. In every case the orientation of the ellipsoid is that which agrees with the received theory. Moreover, the spots are elliptic in the cleavage-plane itself, being elongated, as Dr. Sorby pointed out fifty years ago, in the line of cleavage-dip. If the cleavage-plane were a plane of shearing, it would correspond with a circular section of the ellipsoid.

We might object further that, since there are two directions of circular section, or of shearing, there should, on Dr. Becker's hypothesis, be always two directions of cleavage, perpendicular to one another with incipient cleavage and making an acute angle in well cleaved slates. Our author endeavours to meet this difficulty in discussing his shearing experiments. One direction of shearing is parallel to a fixed face of the block undergoing deformation, while the other is continually changing, "so that any one set of particles undergoes maximum tangential strain along these planes only for an infinitesimal time." Even assuming such conditions to be realised in nature, which cannot be the general case, we should still suppose that the cleavage-property (as distinguished from fractures set up in the process of deformation) will depend on the actual structure of the rock, not on the manner in which that structure has been arrived at.

It will be apparent from the foregoing criticism that, while recognising the intrinsic value of these experiments and the clear manner in which the author's views are set forth, we do not find in them anything which assails successfully the generally accepted interpretation of the cleavage structure. A. H.

[1] "Experiments on Schistosity and Slaty Cleavage." By George F. Becker. Pp. 34; 7 plates. *Bull.* No. 241 of U.S. Geological Survey. Washington, 1904.)

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—By direction of the Board of Geographical Studies, part ii. of the examination for the diploma in geography will be held on June 21 and two following days. No person is qualified for admission to part ii. who has not previously passed part i. (or the special examination in geography for the ordinary B.A. degree). The names of intending candidates, together with the subjects they propose to take up, should be notified to the registrary not later than May 24. The fee for admission to the examination is, for members of the university, 3*l.*; for persons not members of the university, 5*l.* The fee must be paid to the registrary not later than June 15. The subjects are regional geography, surveying and mapping, geomorphology, oceanography and climatology, the history of geography and anthropogeography. Copies of the schedules defining the range of examination may be obtained by application at the registry.

The council of the Senate has recommended that the University of Queen's College, Kingston, Ontario, be adopted as an institution affiliated to Cambridge University.

It is understood that the syndicate for considering the studies and examinations of the university, the report of which in favour of the abolition of compulsory Greek in the previous examination was thrown out last term, will continue to meet. It is proposed to add to the syndicate Mr. E. S. Roberts, master of Gonville and Caius College; Dr. Adam, one of the tutors of Emmanuel College; Mr. S. H. Butcher, late professor of Greek at Edinburgh University; and Mr. G. H. Hardy, of Trinity College. These gentlemen were on the "non-placet" side at the