Even those who are content to work at the development of the lowlier types, such as the worm and the cray-fish, are helping at this good work, for they are throwing light upon the evolution of the Vertebrates.

VII. "On the Chemical Composition of Aleurone Grains." By Sydney H. Vines, B.A., B.Sc., F.L.S., Fellow and Lecturer of Christ's College, Cambridge. Communicated by Dr. Michael Foster, Prælector of Physiology in Trinity College, Cambridge. Received October 22, 1878.

I. *The Aleurone Grains of the Blue Lupin.* (*Lupinus varius.*)

The proteids stored up in the seeds of certain plants, more especially of Leguminosæ, have been stated by various observers to exist in the form of the vegetable caseins such as Legumin and Conglutin, and this view has been advocated of late years more particularly by Ritthausen ("Die Eiweiss-Körper der Getreidearten, &c., 1872"). In 1877, Weyl published some observations ("Zeitschr. für Physiol. Chemie, Bd. I), which tend to show that the proteids exist in the seeds of these plants in the form of globulins, and that the caseins, extracted by Ritthausen and others, are the products of the alteration of the globulins effected by the reagents (alkaline solutions) used in their extraction.

In order to be in a position to form a decided opinion upon the subject, I first repeated Weyl's experiments, using the seeds of the blue lupin. I found that on treating the ground seeds with 10 per cent. NaCl solution, I obtained a fluid which gave all the reactions characteristic of fluids which hold globulins in solution. On dilution with water it gave a precipitate of a substance soluble in 10 per cent. NaCl solution (vitellin); and on saturating it with NaCl (rock-salt), a substance (myosin) was precipitated which was soluble in 10 per cent. NaCl solution.

With the view of ascertaining the value of Weyl's suggestion, that the casein (conglutin, Ritthausen) contained in the lupin was a product of the alteration of the globulin under the action of an alkaline solution, I made the following experiment: — About 50 grms. of the ground lupin-seeds were placed on a filter, and 250 cub. centims. 0·1 per cent. NaHO solution poured over them. The fluid ran through in a few minutes, and was found to give the reactions characteristic of alkaline solutions of vegetable casein (*see* "Sachsse, Chemie und Physiologie der Farbstoffe," &c., 1877, p. 267). The residue on the filter was then well washed with distilled water until the washings ceased to give an alkaline reaction. It was then treated with 250 cub. centims. 10 per cent. NaCl solution, and on testing the filtrate it was

found to hold much globulin in solution. The residue on the filter was then placed in a beaker with 500 cub. centims. of the 0·1 per cent. NaHO solution, and allowed to stand for twenty-four hours. At the end of that time the alkaline fluid was poured off, and the residue placed on a filter and well washed with distilled water. On treating it with 10 per cent. NaCl solution it was impossible to extract from it more than the merest traces of globulin. It appears, therefore, that the globulin had become altered by the action of the alkaline fluid, that it had in fact become dissolved in it in the form of alkali-albumin. This change probably occurs in the extraction of conglutin by Ritthausen's method.

Moreover, I found that conglutin prepared according to Ritthausen's methods gives reactions which are characteristic of the substances formed when various animal proteids are treated with dilute acid or alkaline solutions (acid-albumin, alkali-albumin), and it does not differ very widely from these substances in elementary composition. These facts support the view that conglutin is merely a product of the alteration of the true reserve-proteids. Weyl had already shown that no proteids, except such as are soluble in 10 per cent. NaCl solution, can be extracted from the seeds by treating them with 1 per cent. Na_2CO_3 solution. This proves that conglutin does not pre-exist in the seed.

I therefore agree with Weyl in concluding that the proteids stored up in the seeds of the blue lupin consist of globulins (vegetable vitellin and vegetable myosin).

Subsequent observations, however, assured me that this is not the only form in which the reserve-proteids are present. I found that the 10 per cent. NaCl extract of the seeds contained, in addition to the globulins, a proteid in solution, which was not precipitated by boiling, or by saturation with rock-salt, or by dilution with distilled water. This substance may be isolated by extracting the ground seeds with distilled water; boiling the extract several times to remove all traces of globulin; evaporating to small bulk over a water-bath, and allowing the fluid to filter into absolute alcohol. As it drops into the alcohol a dense precipitate is formed. The substance which is thus precipitated is readily soluble in distilled water even after being exposed for months to the action of alcohol. Its solution in distilled water does not become turbid on boiling; it gives a precipitate on the addition of a drop of HNO_3, which is soluble in excess of acid; it gives the xanthoproteic and Millon's reactions; it gives an immediate precipitate with acetic acid and potassic ferrocyanide; and it gives a bright pink colour when treated with excess of strong NaHO solution on the addition of a drop of dilute $CuSO_4$ solution. The substance does not dialyse. These properties and reactions indicate that the substance is allied to the peptones. It most nearly resembles the *a* peptone of Meisoner, or,

adopting Kühne's nomenclature ("Verhandl d. Nat.-Med. Vereins zu Heidelberg," Band I, 1876), the substance to which he gives the name of Hemialbumose; a name which may be provisionally applied to this substance also.

The proteids stored up in the seeds of the blue lupin are therefore of two kinds:

(1.) Hemialbumose—soluble in distilled water.

(2.) Globulins—insoluble in distilled water, but soluble in 10 per cent. NaCl solution.

In order to determine the exact distribution of these substances in the cells of the seed, I made a series of micro-chemical observations. Thin sections of the cotyledons were placed for a few minutes in ether and then in absolute alcohol, in order to remove the fatty matters present which would otherwise interfere with the observation. A section examined in a drop of absolute alcohol shows the cells filled with aleurone grains lying in the meshes of a delicate matrix. They are hyaline or faintly granular, and have a yellowish tint. On adding a few drops of distilled water the grains become coarsely granular; the granules gradually disappear, and then vacuoles make their appearance. Further treatment with water produces no apparent change. If now a few drops of 10 per cent. NaCl solution be added, the hyaline vacuolated grains at once disappear, and nothing remains in the cells (when the section is very delicate) but the network of the matrix. A precipitate may be produced in the fluid under the cover-slip by diluting it with distilled water. The precipitate assumes the form of rounded drops of a viscous nature which are readily redissolved on the addition of NaCl (vegetable vitellin). If the section be irrigated with 10 per cent. NaCl solution until the addition of distilled water produces no precipitate, and if it be then well washed with distilled water nothing remains within the cells but the matrix. This is rendered conspicuous by adding a drop of solution of iodine which gives it a bright yellow colour.

It is well known that aleurone grains consist essentially of proteids, but the nature of these proteids has not as yet been determined. From the foregoing observations it appears that at least one proteid is present which is soluble in water, and one which is insoluble in water but soluble in 10 per cent. NaCl solution. The preceding chemical experiments suffice to prove that the former is hemialbumose, and that the latter includes the two forms of vegetable globulin.

My observations on the solubility of the aleurone grains of the blue lupin in water agree in the main with those of Pfeffer ("Unters. über Proteïn-Körner, &c. Jahrb. f. Wiss. Bot.," Band VIII, 1872, p. 447), but I have been unable to discover that, as he asserts in the case of Pæonia and Cynoglossum at least, long continued exposure to alcohol diminishes their solubility in water. Such treatment affects neither

the solubility of the hemialbumose in water, nor that of the globulins in 10 per cent. NaCl solution, but it renders the protoplasmic matrix of the cells quite insoluble in dilute alkaline solutions. These facts were established by experiments with grains which had been in alcohol for three months.

I have detected the presence of hemialbumose in the seeds of vetches and of the hemp and flax plants, and I propose to study the mode of its occurrence in the seeds of these and other plants, as I have already done in the case of the blue lupin, and further, to determine what is its exact significance in the process of germination.

VIII. "Report on Phyto-Palæontological Investigations generally and on those relating to the Eocene Flora of Great Britain in particular." By Dr. CONSTANTIN BARON ETTINGSHAUSEN, Professor in the University of Graz, Austria. Communicated by Professor HUXLEY, Sec. R.S. Received December 12, 1878.

When, about thirty years ago, I began to direct my attention to the study of the fossil Flora, the knowledge of fossil forms of plants was confined almost exclusively to forms of the Palæozoic formations. Of the Tertiary Flora there existed at that time a very imperfect conception; but few beds of Tertiary plants were known, and these had been only superficially examined. Leaf-skeletons had not been examined, and consequently the characteristic marks upon them were not available for the purpose of instituting a comparison with the fossil leaves. The fossils themselves were only obtained from stones which had been exposed to the air, and were easily split asunder, and it was thus impossible to arrive at any accurate knowledge of the nature of the old world plants. In fact, parts of one and the same plant were often regarded as plants of different genera. Thus on making a closer and more careful investigation into the Coal Flora of Bohemia, I was able to show that the *Asterophyllites* are the branches, and the *Volkmanniæ* the fruits of the Calamites.

It appeared to me, therefore, necessary that I should devote myself to the study of the so-much-neglected Flora of the Cainozoic formations. With this object in view, I determined:—

Firstly, to collect fossil plants as completely as possible, in order that my investigation should produce results on which I might entirely rely.

Secondly, to improve the method of investigation, especially with regard to the working out of the skeletons of the leaves of living plants, so as in that way to acquire sure standpoints from which to determine the species of the fossil leaves.

Thirdly, not to confine the scope of the inquiry within the limits of