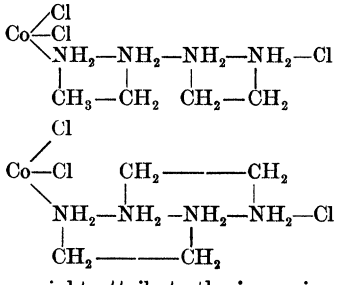
ethylene diamine, we can imagine two possible arrangements with the cobaltammine molecule—



so that we might attribute the isomerism in these compounds to this difference. Now, in the ammonia compounds such an isomerism could not occur, owing to the similarity of all four ammonia groups. We should therefore expect to find no isomerism in the case of the ammonia-compounds of the type $[(NH_3)_4CoCl_3]$; *and, as a matter of fact, no such isomers are known; the compound exists in one form only.*

And again on page 125, in summarizing the whole controversy, the author states:

The question at issue is quite clear. Jörgensen points out that if we take the three cases of the dichloro-diethylene-diammino salts, the dinitrito-tetrammino salts and the dichloro-tetrammino salts, two isomeric series are known in the case of the first two sets, but the dichloro-tetrammino compounds occur in one form only—

$\left[Co\begin{matrix}Cl_2\\en_2\end{matrix}\right]X$ Occur in two forms.

$\left[Co\begin{matrix}(NO_2)_2\\(NH_3)_4\end{matrix}\right]X$ Occur in two forms.

$\left[Co\begin{matrix}Cl_2\\(NH_3)_4\end{matrix}\right]X$ Only one form known.

So that in each case where isomerism is observed there are either two nitro-groups or two ethylene diamine molecules. Where these are both absent, no isomerism occurs. Werner, on the other hand, maintains that his theory accounts better for the facts, *though he has not been able to produce the two isomeric tetrammino salts which, according to his views, ought to exist.* The non-production of these salts is specially significant when we consider how easily we can transform one di-ethylene-diamine isomer into the other; evaporation with mineral acids produces one form, from which the other can be regenerated by evaporating with water after making the solution neutral.

Briefly, Dr. Stewart contends that Werner's views are untenable as he has not been able to prepare the isomeric modification of dichloro-tetrammino cobaltic chloride. This is the crowning argument with which the chapter is closed.

Unfortunately for the argument, Werner published in 1907 in so accessible a journal as the *Berichte der Deutschen Chemischen Gesellschaft,* Vol. 40, p. 4817, a full account of the discovery, the method of preparation, and the properties of this second and isomeric modification of dichloro-tetrammino-cobaltic chloride. This was no accidental discovery, nor the result of haphazard experiment, but a logical consequence of the extension of Werner's views to the complicated poly-nucleal compounds, a field brilliantly developed by Werner during the past twelve years, but not mentioned in the chapter on Cobaltammines.

The critic can not afford to be careless in keeping up with the literature of a subject. The plea of recent publication of Werner's work on this compound can not be put forward, as Dr. Stewart has included in this chapter the still later (1908) published views of Ramsay and of Friend; indeed, the date of his preface, September, 1909, shows that the manuscript was in hand two years after Werner's announcement in the *Berichte* of his success in preparing the isomeric modification of dichloro-tetrammino-cobaltic chloride.

CHAS. H. HERTY
UNIVERSITY OF NORTH CAROLINA,
CHAPEL HILL, N. C.,
December 16, 1910

SCIENTIFIC BOOKS

The Differentiation and Specificity of Corresponding Proteins and Other Vital Substances in Relation to Biological Classification and Organic Evolution. The Crystallography of Hemoglobins. By E. T. REICHERT and A. P. BROWN. Washington, D. C., published by the Carnegie Institution of Washington. 1909.

This is an important and very interesting work, the combined production of a physiologist and a crystallographer. This review will be restricted to a consideration of some

of the results that are of interest to the biologist.[1]

Hemoglobin, the coloring matter of the blood, which in vertebrates is contained in the blood corpuscles, and which is a combination of a proteid, the globin, with the coloring matter proper, the hematin, can more or less readily be obtained in the form of crystals. Many investigators have studied the conditions under which these crystals form and some of their characters in different species of animals. The work of Reichert and Brown is, however, by far the most thorough and extensive investigation which has so far been published, and on the basis of their careful studies the authors arrive at broad biological conclusions, which will be of great interest to a wide circle of scientists.

The results obtained leave no doubt that the crystals of the hemoglobin of different species are not identical, and the work, moreover, raises problems which have not been considered by previous investigators. The authors show that not only do the crystals of different species of animals differ, but also that this difference is a graded one, corresponding to the position which the various species occupy in the zoological system. As the crystals of nearly related species resemble each other more closely than those of more distantly related species, the character of the crystals permits us to decide, within certain limits, how nearly related to each other animals are. Furthermore, inasmuch as crystallographic characters are the expression of chemical constitution, we may conclude that the hemoglobin of various species shows gradations in its chemical constitution corresponding to the close or more distant relationship of the species. We may also assume that gradations parallel to those shown by the crystals of hemoglobin exist in the other proteins. Thus we have a means of testing by crystallography the classification of animals, which at present is based almost entirely on morphological characters.

The comparative study of the crystals of hemoglobin by the authors confirms, on the whole, the correctness of the classification generally adopted by zoologists, but there are certain instances in which the authors believe that their findings suggest a revision. To cite two examples: (1) It is ordinarily assumed that the white rat is an albino of the black rat; the crystallographic examination of the various species of rats shows, however, that the white rat is closely related to the brown or Norway rat, while the black, or Alexandrine rats are more nearly related to each other. (2) The crystals of hemoglobin from the brown bat show a considerable resemblance to the crystals of hemoglobin of Papio, which belongs to the primates. This agrees with the view of some zoologists, according to which the bats are related to the primates, although, on the other hand, the crystals of the fruit bat do not show this resemblance to those of Papio.

On the whole, the main results of Reichert and Brown harmonize very well with our general biological conceptions of the graded relationship of differences in the chemical constitution of proteid substances, a conception mainly founded upon the results obtained through the application of the so-called biological tests (precipitin, anaphylaxis, complement fixation reactions), and especially are the conclusions of these authors in good agreement with the results of experiments in which watery extracts of erythrocytes have been used as an antigen and in which the erythroprecipitins obtained were shown to be specific for the antigens of the various species which had been employed. These studies have definitely proved that the proteid substances from

[1] The reviewer consulted two experts in crystallography in regard to the soundness of the crystallographic basis of the work, and he may be permitted to cite here a few sentences:

Professor Edward H. Kraus, of the University of Michigan, states: "From the crystallographic standpoint, Professor A. P. Brown has done a remarkable piece of work which is deserving of highest credit."

Dr. J. E. Pogue, of the Smithsonian Institution: "The actual crystallographic and optical details are apparently determined with skill and accuracy. The photomicrographs are excellent, and the line drawings good."

the various organs of a certain species have in common a "species" group that is characteristic for one species and differentiates it from nearly related species. By these "biological" methods it had also been found that the constitution of these groups of proteid is more similar in nearly related than in more distantly related species, and several investigators, especially Osborne and Abderhalden, had previously taken up the problem of the chemical characterization of species differences by the methods of analytical chemistry.

The work of Reichert and Brown differs, however, in some important aspects from the previous investigations (differentiation by biological tests). While in the latter the substances compared with each other were usually chemically not well defined, Reichert and Brown worked with a definite chemical substance, the hemoglobin. By the method of crystallization it is, moreover, possible to detect differences in chemical constitution which are at present not accessible to ordinary chemical analysis and in this way it is possible to differentiate between species so nearly related, that even by means of the so-called biological tests the differentiation is accomplished only with great difficulty.

After a study of Reichert and Brown's work little doubt is left in the mind of the reader in regard to the usually close relationship of the crystals of the species belonging to one genus or occasionally even of the great similarity of the crystals of two nearly related genera; it seems, however, not yet established that a *general* parallelism exists between the true relationship of the various orders and classes of animals and the character of their hemoglobin crystals.

It might furthermore be questioned in those cases in which a divergence seems to exist between the ordinary classification and the results of the crystallographic studies, whether the latter should be accepted unhesitatingly. It rather seems that in such cases of doubt a comparative study by the crystallographic, and by the so-called biological tests should be used to confirm the former. This would be especially desirable in view of the great lability of the hemoglobin molecule which the authors themselves repeatedly emphasize. We might, *e. g.*, question whether the different kinds of crystals of oxyhemoglobin found occasionally in the same blood might not be the result of certain secondary chemical changes in the hemoglobin molecule. In this connection it is of interest that in a recent publication Offringa states, that if the crystals of hemoglobin of the horse are prepared without the addition of any salt (Reichert and Brown made use of oxalates in their work), only one kind of crystals is obtained.

In the work of Reichert and Brown, as well as in the more recent literature generally, the term "specific" is frequently encountered, and it is apparently supposed to have a definite biochemical meaning. A more searching analysis, however, reveals the fact that this term includes three different relationships between substances, and a clear distinction between these appears to be very desirable. Several years ago the reviewer described a class of substances which he designated as specifically adapted; these are substances coexisting in the same organism and showing functional relations to each other. In other cases the term "specific" merely indicates a character of a certain species by which it differs from other species, without any parallelism existing between this characteristic and the zoological classification. In a third class of specific characters such a relationship exists, and this third kind of specificity might appropriately be called "generic specificity." With the latter, we have principally to deal in the work of Reichert and Brown.

The work of these authors includes also a consideration of the general characters of hemoglobins as well as a summary of other differences which have been found in the blood of different species by previous investigators. With some opinions expressed in this part of the book issue might, perhaps, be taken, as for instance, in regard to the low estimate of the physiological importance of iron as a constituent of hemoglobin; a view

against which especially the recent investigations of W. Manchot might be cited.

The fine reproduction of 100 plates of beautiful microphotographs of hemoglobin crystals of various species of animals is especially noteworthy.

Leo Loeb

A Monograph of the Culicidæ or Mosquitoes. Volume 5. By Fred V. Theobald. British Museum (Natural History). London. 1910. Pp. xvi + 646. 261 text figures, 6 plates.

The author has assembled in this volume descriptions of many recently erected genera and species, characterized thirteen genera and eighty species as new, supplied keys for the separation of the genera and a very large proportion of the described species and, in addition, gives observations or references to practically all other genera and species. This latter makes the fifth volume practically a systematic index to the preceding four volumes and will greatly facilitate future studies in this group.

The modified classification proposed by Lutz and outlined in volume four has been closely followed. We regret to note that the tables for the recognition of the genera are based largely upon scale structure, a method of separation which has found comparatively slight favor in America, though we can not ignore the author's statement, especially in view of his wide experience with these insects from all parts of the world, that separation in this manner is comparatively easy, as evidenced by the number of correctly named collections received at the British Museum. The monograph, as a whole, is weak from a structural and biological standpoint, and necessarily so in many instances, especially in the case of forms received from distant countries where methods of collection and preservation are far from ideal. The study of the imago must, as a rule, precede biological investigations, and it is therefore not surprising that the immature stages have received comparatively little attention in this work. We sympathize strongly with the author in his declining to recognize genera and species based solely upon larval characters, despite the fact that such procedure is not sanctioned by the International Code of Zoological Nomenclature. It is true that good characters are found in the larvæ of this group, and that in some instances species are more readily separated in the larval than in the adult form. Nevertheless, our classification of the family is based upon the imago, and confusion is bound to result from the employment of a double standard; though technically allowable, it is in this group questionable procedure.

There are important problems in synonymy which should be settled in the near future for the purpose of avoiding confusion if for no other reason. The author declines to accept the broad delimitation of Aedes, recently proposed in this country, and, as a consequence, the nomenclature used by a number of American workers differs widely from that employed in the volume under consideration. Personally, without having made special study of the problems involved, we question the wisdom of attempting to unite under one name such diversified forms. On the other hand, a number of generic names have been allowed to stand as valid in this work which will probably fall as synonyms because of the absence of satisfactory characters. These and similar questions can be settled only by an exhaustive comparative study of the characters presented by the immature stages as well as those of the adult. The key to the solution of many of these problems will be found in the unrivaled collections from all parts of the world, now assembled in the British Museum of Natural History.

The diversity and size of this group is indicated by the eight subfamilies recognized (excluding the Corethridæ), comprising some 146 genera and 899 species, a large majority of these being valid. The world owes Professor Theobald a debt of gratitude for assembling, carefully describing and arranging this immense amount of material, among which are included some of the most dangerous insect enemies of man. Prior to this study, our knowledge of the Culicidæ was