and Williamson's "Fern Etchings," are signs of the healthy growth of popular interest in the objects of the Science.

Among the lower orders of plants, systematic work has not been so vigorous. The literature is widely scattered, and of many of the groups is in a most dishearteningly chaotic state. The disentangling and critical arrangement of this matter is at present one of the most important services that could be rendered the student. The labor of consulting all the descriptions belonging to any one group is often very great, and is always accompanied with a doubt if complete success has been attained. Further perplexities are the unequal value of the material when found, and the difficulty of determining synonymy. Monographs of the groups are exceedingly desirable; but such exhaustive studies are not often made, and in lieu of them careful compilations, aided by as much investigation and verification as possible, are very useful. Professor Bessey's "Erysiphei," Mr. Peck's "United States Species of Lycoperdon," and Dr. Halsted's "American Species of Characeæ" are admirable examples of such contributions to the advancement of knowledge.

It is a law in the growth of a biological science that the objects with which it deals must be carefully identified and systematically described before much progress will be made in the recondite investigations of structure and development, and the relations to physical forces, or in the higher problems regarding the *rationale* of forms and processes. Every advancement in morphology and physiology, however, reacts upon classification and helps to establish it upon a more satisfactory basis. While systematic work is thus the very foundation of the science, it is only by following it up in the same zealous manner with anatomical and physiological researches that the science makes most substantial advancement.

It is manifestly the natural and wise thing for American botanists to collect herbaria and study floras till the species and their distribution are fairly known. For Phanerogams and Ferns this has been well accomplished, and approximately so for Mosses and Liverworts, but the Thalloyhytes (Algæ and Fungi) remain comparatively unknown. Not but what there is still room for excellent systematic work among Phanerogams, but that the stumps and stones and other obstacles in the field have been pretty fully cleared away and it is now a matter of plain cultivation, while the other departments of the science need earnest workers who are not afraid of difficulties, and are willing to clear up and cultivate single handed as large areas as possible.

In the article cited, the Professor feels called upon to apologize for the neglect of Anatomy and Physiology during 1879. He says:—"While we may regret that so much of the field has been so sadly neglected in our country, we should remember that, as a rule, our botanists are overloaded with other duties which render it often impossible for them to command the time for making the necessary investigation." Admitting that the plea partly accounts for the inactivity, it still does not seem to touch the chief cause of the difficulty. It is rather to be ascribed to a lack of enthusiasm for these subjects. They have not yet come into vogue with lovers of the science: the tidal wave of laboratory and experimental Botany is yet but slightly felt; the problems seem new and strange, and just where and how to attack them appears obscure and uncertain. The work already done in these fields has mainly related to the means and accompanying phenomena of the fertilization of flowers. Some excellent papers have been published, although not lengthy. Histology, Embryology, and Physiology proper, however, appear almost without followers, judging from the results communicated. At the present time, Germany is the centre of the most active researches relating to the latter subjects, and France is not far behind.

In order to keep informed of the latest discoveries and results in the botanical world, an acquaintance with the journals in which they are announced is imperative. It is a trite saying in matters of daily life, that if one wishes to be "posted" he must read the papers. This applies even more forcibly to botanists, because their usual isolation deprives them of most other means of obtaining botanical news.

Among the most important exclusively botanical journals are the following: *Botanisches Centralblatt*, abstracts of the latest writings, and a full index, for all departments of the science; *Botanische Zeitung*, anatomy and physiology chiefly; *Flora*, general botany; *Pringsheim's Jahrbücker.*, physiological botany; *Hedwigia*, cryptogams; *Annales des Sciences Naturelles Botanique*, general botany, but with a large share of anatomy and physiology; *Bulletin de la Société Botanique de France*, general botany; *Journal of Botany*, largely systematic; *Grevillea*, cryptogams; and the two home journals—*Bulletin of the Torrey Club*, largely systematic; and *Botanical Gazette*, general botany, but inclined towards physiology. The first two of the list are weeklies; *Flora* is issued in thirty-seven numbers, and the others are monthlies. Beside these there are a large number of periodicals which devote considerable space to botanical matters, such as the *Quarterly Journal of Microscopical Science, Hardwicke's Science Gossip, American Naturalist, American Monthly Microscopical Journal*, etc. If one were confined to two, probably the *Botanische Zeitung* and the *Bulletin de la Société Botanique*, would prove the most satisfactory, presuming that the home journals are also taken, as a matter of course. Mr. Douglas, of Richland, N. Y., proposes to issue a translation of the *Zeitung*, for less than the subscription price of the original (but without the plates, we suppose). This laudable undertaking should receive substantial encouragement from English speaking botanists.

Probably there is no better indication of the beginning of a new era for American botany, than the changes made in the recent text-books. Dr. Gray's "Botanical Text-book" is expanded into four volumes, treating of the Morphological Structure of Phanerogams, Histology and Physiology, Cryptogams, and the natural orders of Phanerogams, respectively. The second volume is to be written by Dr. Goodale, and the third by Dr. Farlow. The first volume of the series has already appeared.

THE DETECTION OF STARCH AND DEXTRIN.

By Spencer Umfreville Pickering, B. A., Oxon.

In conducting some experiments in which it was necessary to ascertain the presence or absence of starch in a liquid containing various amounts of dextrin, the few facts here described were brought to light, and may, perhaps, be of sufficient interest to warrant their publication.

When a solution of starch which has been colored blue by the addition of iodine is heated, it is found that the temperature at which the color disappears varies with the intensity which it possessed before heating. Thus, for instance, 100 c. c. of a rather dark iodine-starch solution on being heated gradually in a flask became perfectly colorless at 58° C., and, on being cooled, showed a slight reappearance of color at 49° C., whereas an opaque blue solution did not lose its color till heated to 99° C., and became visibly colored again when cooled to 63° C. Similarly variable results were obtained by experimenting on iodine-starch solutions in sealed tubes, the temperatures of reappearance being much more constant (generally about 50° C) than those of disappearance; this no doubt is due to the fact that, the stronger solutions having been heated to a higher temperature than the weaker ones in order to effect the disappearance, a greater quantity of the iodine present in them would have been converted into hydriodic acid, and this would tend to an equalization of the amounts of iodine present on cooling in the various cases. Owing to this conversion of iodine into hydriodic acid, the solutions on cooling, as might be expected, are considerably lighter than they were before heating, and their intensity naturally depends to a great extent on the rapidity with which they have been cooled; even a very weak iodine-starch solution which has been heated may be made to re-assume its color if cooled very quickly.

The amount of starch which may be recognized by means of the iodine reaction varies, of course, with the bulk of liquid operated upon. Using about 200 c.c. the weakest solution which gives an easily discernable blue tint in a beaker contains about 0.0001 per cent. of starch, while if small quantities are examined in a test-tube this percentage must be doubled in order that the color may be rendered visible. The green color which is noticed when a large quantity of iodine is added to a weak solution of starch, appears to be due simply to the combination of the proper yellow color of the free iodine with the blue color of the iodine-starch.

When two weak solutions of iodine, to one of which some starch has been added, are exposed to the air in an uncovered beaker, the iodine in both cases disappears entirely in the course of a few days, but more slowly from the solution which contains the starch; hence the iodine which disappears (owing partially to its volatilization into the air and partially to its hydrogenation) seems to be retained to a certain extent by the presence of starch. The presence of iodine has a reciprocal action in the preservation of starch. A solution of starch, which, in a few days, is converted into dextrin, may be preserved unaltered for a long time—possibly for an indefinite time, if an excess of iodine is present in it.

When a sufficient quantity of iodine is added to a solution of dextrin, a deep brown color is produced; the colored compound which is here present is in a state of true solution, whereas in the case of starch it will, as is well known, settle entirely to the bottom of the liquid in deep blue flocks, leaving the supernatant solution quite colorless, and these flocks on agitation are disseminated again so as to form an apparent solution. The dextrin reaction with iodine is not nearly so delicate as that of starch; the weakest solution which gave any discernable color on being tested contained 0.005 per cent. of dextrin, and in this case the color could only be detected by using about 200 c.c. of the solution, and comparing the color with that of some iodine solution of the same strength as that to which the dextrin had been added.

With starch, the first drop of iodine which is added produces a permanent coloration. With dextrin, however, this is not the case; the color produced by the first drops disappears instantly and entirely. A considerable quantity must be added before a moderately permanent color is produced, and the reaction, owing to which the iodine disappears in this way, will continue for six or seven days. Whether the dextrin disappears or not at the same time has not been ascertained, although it seems most probable that it should do so.

When a solution of iodine-dextrin is heated, the color becomes lighter and gradually disappears, as in the case of iodine-starch, but the temperature at which this disappearance takes place is considerably lower. An opaque brown solution on being heated in a flask became colorless at about 81° C., and, on cooling, regained its color with considerable diminution in intensity) at 64° C. A solution of one-quarter the strength of the preceding one lost its color at 52°, and regained it on cooling at 34° C.; here also, as in the case of iodine-starch, we find that the colored principle does not become colorless at any particular temperature, but its disappearance is dependent on its original intensity.

The dextrin usually met with in commerce contains a considerable amount of starch, which, however, may be entirely converted into dextrin by prolonged heating at 140° to 160° C for several hours, after which it gives the pure brown reaction with iodine above mentioned.

When iodine is added in excess to a mixture of starch and dextrin, the colors produced are blue, violet, purple, claret, red-brown, or brown, according to the various proportions in which the two substances are present. When the iodine is added gradually to the mixed solutions the colors produced, both temporary and permanent, follow the same order as those above mentioned, the blue colors appearing first, and the red ones only on the addition of larger amounts of iodine. Conversely, when the colored solution is allowed to stand, the red tints disappear first, and the blue ones last. Obviously, therefore, the gradual addition of iodine affords an easy and delicate means of detecting starch in the presence of even a large amount of dextrin. Another way in which starch may be detected in similar cases, is to add an ample sufficiency of iodine to produce a permanent color, and then to heat the liquid; the brown iodine-dextrin is decomposed at a comparatively low temperature, while the blue iodine-starch remains till the heat is raised considerably higher, and again, on cooling, the blue tint reappears long before the brown or red tint does; even when there is not sufficient starch to yield satisfactory results by this method, it may often be detected by the liquid being of a more bluish tint after the heating than it was before it.

O. Knab (*Chem. Centr. Blatt*, 1872, 492) found that some dextrin which he had prepared by repeated (ten times) precipitation with alcohol gave the reaction of a mixture of dextrin and starch, and hence concluded that it still contained some of this latter substance. It appears superfluous, however, to raise an impure preparation to the dignity of a chemical compound by giving it a distinct name—dextrin-starch—as Knab does. On leaving a mixture of solutions of starch and dextrin for some days, Knab found that, whereas the addition of iodine had at first caused a deep blue coloration, after a time nothing but the red or brown color of iodine-dextrin was produced, and hence draws the somewhat startling conclusion that starch under the influence of dextrin is converted into dextrin. A simpler and more probable conclusion from these experiments would surely have been, that at the end of the few days during which his experiments lasted, the starch had suffered that spontaneous decomposition to which it is, as is well known, so prone, leaving in solution nothing which would give a coloration with iodine but the unaltered dextrin.

Dextrin and starch, it appears, give entirely different reactions with iodine; the former combines with the halogen to form a brown soluble substance, whereas the latter forms with it a deep blue insoluble body; and these two reactions are so distinct that presence of either of the reagents may be easily detected in a solution containing both of them.

The fact that the addition of iodine to dextrin produces only a transitory color at first, and that an excess of it is necessary to give a permanent tint, will, no doubt, explain the various discordant statements which exist as to whether any color is produced by the mixture of these two substances or not, and will probably render unnecessary the theory of there being two or three different dextrins, as proposed by Mulder and Griessmayer.

Determination of the Fatal Dose of Carbonic Oxide for Various Animals.—Air containing 1-300th of its volume of carbonic oxide proved fatal to a dog when inhaled for fifty minutes. In another dog of the same size the fatal dose was 1-250th. A rabbit resisted various proportions up to 1-60th. A sparrow perished with 1-500th.—M. Grehant.