once a guarded and sacred preserve, is now a commons or thoroughfare through which any vagrant, motley procession of thoughts may troop at will without let or hindrance.

No doubt, too, this open, unguarded condition of consciousness may come upon us at times simply from our relaxing nervous tension, as when we unharness the will and turn it loose, and lapse generally into a state of mental passivity and listlessness. It is then that, finding the door left ajar, these unbidden recollections oftenest make their intrusive entrance.

Perchance, too, Unconscious Cerebration may take advantage of the situation to display and call attention to some of its remarkable curios, and, abusing the opportunity, lug in with these certain annoying remembrances which we would it had left in undisturbed oblivion.

Perhaps one of the most significant and suggestive revelations that comes to us from a thoughtful observation of these extraordinary phenomena of involuntary recollection, is the abundant proof they furnish us of the unexpected and marvellous tenacity of our impressions.

It is made very manifest that those potential organic conditions which were set up and established in the original process of developing these impressions are still preserved to us intact, and need only the proper excitant or stimulus to revive and rehabilitate them for us again and again.

Being well assured of this, it would seem profitable for us to inquire to what extent, not yet realized, can we, by a deliberate and persistent exercise of the will, control and compel these conditions of revival.

We are all conscious of doing a good deal of recollecting by *voluntary* effort, but it is mostly those ordinary experiences which are comparatively recent and fresh. When it comes to making labored and prolonged effort to restore some elusive and faded image of a remote past, we are easily discouraged, and, even though it be a momentous event in our lives, a vivid and complete recollection of which might save us from dishonor or utter ruin; yet, after making a few hopeless and abortive attempts to remember, we are apt to give up in despair, when, perhaps, had we been fully possessed with an abiding faith in the enduring nature of our impressions and in the possibility of our reviving them, no matter how remotely fixed, we might have hopefully and courageously continued our efforts, even for days or weeks if necessary, until the missing fact was again brought into the fold of consciousness.

Surely, if, as has often happened in human experience, grave accidents or emergencies have resulted in so quickening and rehabilitating certain conditions of the brain as to fully restore to the person recollection of events long supposed to be irretrievably lost, it demonstrates the reasonableness of our employing and confidently relying upon systematic and patient effort to compel the same active and exalted mental conditions to produce the same happy result.

## THE ARRANGEMENT AND NUMBER OF EGGS IN THE NEST.

BY DR. MORRIS GIBBS, KALAMAZOO, MICH.

All birds have a system or arrangement in depositing their eggs in the nest, and there are very few species, if any, in which some peculiarity is not to be seen, if careful observation is made. Many birds so plainly and invariably show a tendency to a set arrangement that their habit is generally known. It is of these well-known examples that we will speak.

The loon or great northern diver always deposits two eggs. They are almost perfectly elliptical in shape and lie side by side. The eggs are invariably found at over three-fifths of the distance from the front edge of the nest depression, that is, at about two-fifths of the long diameter from the rear end of the elongated hollow or nest proper. From the position of the eggs one can tell how the bird sits on the nest, as we may reason that, with these long-bodied birds, the abdomen, which supplies the direct heat, is well back from the front of the hollow. This theory is verified by watching the incubating bird. The turtle dove, night-hawk, whippoorwill, and common domestic pigeon, each of which lays two eggs at each setting, deposit the eggs side by side, although this arrangement is frequently interfered with in the case of the tame bird, not rarely with the result that one of the eggs does not hatch.

The spotted sandpiper and killdeer plover, and I presume most of the other snipe and plover, lay four eggs at a clutch. The eggs are arranged in the nest, or on the bare ground, with their small ends together, and, as they are pyriform in shape, they join in to perfection. The eggs of the snipe and plover groups are proportionately exceeding large for the size of the bird, and the saving of space by this arrangement undoubtedly answers a purpose. It is impossible to offer a solution to this problem of order at present, unless we may suggest that it is a wise provision of some ruling power, which so ordains the arrangement which best admits of the bird's covering the eggs thoroughly. It is fair to doubt if a sandpiper could cover her four large eggs if they were arranged in any other position besides that in which they are found, with the four smaller ends pointing to a centre. This species has a small body and is not provided with loose, fluffy feathers, so well supplied to many grouse and other birds which lay many eggs. On two occasions the order of the eggs in nests of the spotted sandpiper was broken by us; an egg being turned about with its point presented outward. One of these nests was deserted, perhaps from the interference, but in the other the order was found restored within a day.

Perhaps no bird in America, certainly no other in Michigan, equals the common bob-white or quail in the number of eggs it sets upon. This species not infrequently lays eighteen eggs, and even more are found in one nest, but I can assure the readers that with any other shaped eggs the bob-white could never succeed as a successful setter. I will suggest that my friends with collections at hand compare a set of twenty eggs of the quail with twenty eggs of equal dimensions in longer and shorter diameter of any other species, and observe which lot occupies the smaller space. We may say, for illustration, that the bob-white's egg is triangular, and fits in as no other egg, to my knowledge, can.

With all birds which lay a good-sized clutch, so far as my observations go, the eggs are deposited in almost an exact circular group. The bird must use excellent judgment in thus arranging them, for it is only by this order that they can all be covered properly. Not infrequently when a grouse is startled from her eggs she tumbles one of her treasures from its bed. If the egg is not too far removed, it will almost invariably be found returned to its exact position in the nest within a few hours.

I have been informed that the brown pelicans steal eggs from one another's nests, in order to fill their complements, or at least take possession of those they find lying on the ground and roll them into their nests. Although this does not seem at all likely, for various reasons, I cannot dispute it authoritatively, and, moreover, there were strong proofs that such was the case in many nests that I examined in Florida. These nests, which were near together, often contained four eggs, never more; one to three of which were ready to hatch, the others being fresh, or nearly so. And, again, there would be eggs in the same nest with young over a week old, or young of ages quite ten days variation. But one point was ever observable, the young, or eggs, or both, never exceeded four in number, showing, even if the charge of abduction is proven, that the old birds know their limit.

The cow-blackbird, in imposing its eggs on the care of other birds, not rarely fails in the arrangement of affairs. It is fair to allow that the cow-bird is perfectly able to distinguish its own eggs from those of the blue-bird, chipping-sparrow, and others, which differ radically in size and color from its own speckled, tough-shelled eggs; but I believe it often fails to distinguish its eggs from the quite often similar ones of the chewink and oven-bird. And this failure accounts for its depositing as high as four and five eggs in the nests of the chewink, where there was but one egg of the owner; and again laying four eggs in an oven-bird's nest, which contained no eggs at all of the owner,— both cases undoubtedly oversights, which resulted from its inability to distinguish. It is reasonable to allow that cow-birds have limits as to the number to be deposited, otherwise some unfortunate warbler or other small bird would be overwhelmed. As it is, the cow-bird studies the limits of endurance in its victims and rarely exceeds the bounds. The most eggs I ever found in a nest infested by cow-birds was nine, and the species generally lays only two or three eggs, thus generally keeping the outside limit to six or seven, with the owner's eggs.

## THE USE OF THE TERM "CARBOHYDRATES."

BY W. E. STONE, PH.D., PURDUE UNIVERSITY, LAFAYETTE, IND.

IT has frequently happened in the history of chemistry that names and terms have lost their original significance so soon as the knowledge of the bodies to which they were applied has become more extended. "Organic" chemistry is better named the "chemistry of carbon compounds;" the "aromatic" bodies have disappeared in the broader designation of benzine derivatives. In the same way it appears that we have reached, or already passed, a transition stage in the use of the term "carbohydrates." Treatises on chemistry still retain the old definition of the term, while those familiar with recent progress in this field no longer feel themselves restricted to these ancient limits. It is the purpose of this paper to consider the present status of this subject.

Von Lippmann, in his work "Die Zuckerarten und ihre Derivate," adopts Fittig's view that the carbohydrates are derived from the hypothetical heptatomic alcohol $C_6H_7(OH)_7$, which, by loss of water, forms the simple or complex anhydrides, $C_6H_{12}O_6$ or $C_{12}H_{22}O_{11}$, known as sugars. His treatment ignores the existence of any carbohydrate with less than six carbon atoms, although he says that, with the (at that time, 1882) slight knowledge of the constitution of the carbohydrates, it was impossible to regard this definition as final and complete.

In 1888 appeared Tollens' "Handbuch der Kohlenhydrate," in which the definition of "carbohydrates" was limited strictly to the bodies composed of C, H, and O, containing six carbon atoms, or some multiple of six, and H and O in the same proportion in which they are found in water. But already Kiliani had shown that arabinose, which had long been regarded as a true carbohydrate on account of all its reactions, had really the composition $C_5H_{10}O_5$. Moreover, it had already been established that the best known sugars, such as dextrose, levulose, galactose, and arabinose, had the constitution of aldehydes or ketones of the hexatomic, respectively pentatomic, alcohols. In anticipation, therefore, of evident progress along this line, Tollens remarks in his preface that such bodies as arabinose and the impending erythrose might well be regarded as carbohydrates, but he retains the hexatomic nature as a requirement for the "true carbohydrate," and puts all non-conforming but similar bodies under the head of "den Kohlenhydraten nahestehenden Körper."

Up to this time a sort of understanding had prevailed that the carbohydrates were exclusively products of natural forces. It had also been noted that these bodies gave certain reactions, which were also presented as a basis for the classification given.

These reactions, as stated by Tollens, are:—

1. Reduction of alkaline metallic solutions.
2. Rotation of polarized light.
3. Subject to alcoholic fermentation by yeast.
4. Formation of levulinic acid.
5. Formation of characteristic compounds with phenylhydrazin.
6. Certain color reactions.
7. Solubility, either before or after hydrolysis.
8. Decomposition by heat.

All of which hold strictly true for the hexatomic carbohydrates. This classification was probably as liberal as the state of knowledge at that time would justify.

But this classification is evidently arbitrary and ought not to have weight in comparison with any classification based on chemical constitution. If a similar constitution can be proven for a series of bodies, the fact that they respond to certain reactions will only be additional proof of their relationship. Such reactions must, of course, be general in their nature, while special reactions will only serve to characterize individuals. In this way the class of carbohydrates must eventually include only bodies of certain constitution, while the characteristic reactions will be limited to a smaller number, of more general application. A similar development has taken place in the manner of classifying the hydrocarbons, alcohols, acids, glycerides, etc.

Of the carbohydrates conforming to the old definition, dextrose, levulose galactose, and mannose are types. They respond to the reactions given and have been found to possess the constitution of ketones or aldehydes of the hexavalent alcohol, $C_6H_{14}O_6$. But we know two bodies of the formula $C_5H_{10}O_5$, arabinose and xylose, which are also aldehyde alcohols, and which give the same reactions as their homologues, with the exception of fermentation and the formation of levulinic acid. Again, we know an aldehyde of the tetratomic alcohol erythrit, called erythrose, of the formula $C_4H_8O_4$, which responds to the same general reactions as its homologues. Glycerose, $C_3H_6O_3$, has also been studied and found to correspond to the others of the series in constitution and general reactions. It is even fermentable with yeast like the regular carbohydrates, which shows this to be an intermittent reaction when applied to an homologous series. Beginning again with the group $C_6H_{12}O_6$, we find that there have been prepared synthetically three other homologues representing aldehydes, respectively of the hept-, oct- and nonatomic alcohols. These also respond to the general reactions given, except that they do not form levulinic acid. Heptose and octose do not ferment, but nonose, with its multiple of three carbon atoms, is fermentable.

It is no argument against the carbohydrate nature of these bodies to say that they do not occur in nature, since two of the hexoses (galactose and mannose) have never been found free, but are only known as derivatives of certain natural products. In this respect they are on precisely the same footing as arabinose, xylose, erythrose, and glycerose.

It appears, therefore, that we have an homologous series of aldehyde or ketone alcohols of the general formula $C_nH_{2n}O_n$ with these common properties: 1° sweet to the taste; 2° optically active; 3° reducing alkaline metallic solutions; 4° yielding with phenylhydrazin characteristic crystallinic compounds. Other reactions, such as great solubility, decomposition by heat, and color reactions, are less characteristic, although possessed in common. Those containing three, or multiples of three, carbon atoms undergo alcoholic fermentation with yeast, and this periodical reaction seems an additional argument for their common nature. Individually they yield, when heated with strong acids, characteristic derivatives; for instance, the pentoses yield furfurol; the hexoses levulinic acid; others have not been carefully studied in this direction.

Following are the members of this homologous series which are known, although several additional isomers are possible:—

Triose, $C_3H_6O_3$.— Glycerose.
Tetrose, $C_4H_8O_4$.— Erythrose.
Pentose, $C_5H_{10}O_5$.— Arabinose, xylose.
Hexose, $C_6H_{12}O_6$.— Dextrose, levulose, galactose, mannose, all in isomeric forms.
Heptose, $C_7H_{14}O_7$.— Heptose.
Octose, $C_8H_{16}O_8$.— Octose.
Nonose, $C_9H_{18}O_9$.—Nonose.

By the definition of carbohydrates, now extant, only the hexoses are included. It is the purpose of this paper to propose the extension of this term to all members of the homologous series, on the basis of a common constitution, viz., as aldehydes or ketones of the normal polyatomic alcohols of the aliphatic series. As characteristic properties of all these, must follow their behavior toward polarized light, toward alkaline metallic solutions, and toward phenylhydrazin.

Such a classification would exclude the bodies of the cellulose group, of which there are many, more or less well defined. But it is not yet evident that they possess a constitutional relation to the bodies under discussion, and have certainly no claim to be classed with the aldehyde or ketone alcohols because convertible into them.

As for the disaccharides of the hexoses, to which belong sucrose, lactose, etc., if it be true, as supposed, that they are anhydrides or ether-like forms of the hexoses, then they are entitled