and the statutes framed and adopted. From these statutes we learn that the objects of the association are to be promoted by the appointment of committees charged with the consideration and investigation of questions submitted by the council, by the publication of the results of such investigations and by the holding of conferences and congresses. It was decided at the opening meeting that the first international committees should be appointed for dealing with the questions of nomenclature in mineral and organic chemistry, and with the unification of the modes of stating physical constants. The next meeting of the association is to be held in Berlin on April 13, 1912, with Professor Ostwald as president, and the 1913 meeting is to be held in Great Britain.

UNIVERSITY AND EDUCATIONAL NEWS

THE governor of Pennsylvania has approved a bill giving an appropriation to the Schools of Mines, Engineering, etc., of the University of Pittsburgh, amounting to $400,000.

HARVARD UNIVERSITY has received from the class of '86 $100,000 to be used without restriction for the purposes of the college.

PRESIDENT TAFT, upon recommendation of the secretary of the interior, has forwarded to the senate the nomination of Professor Philander P. Claxton, professor of education in the University of Tennessee, as commissioner of education to succeed Dr. Elmer E. Brown, who recently resigned to accept the chancellorship of New York University.

DR. MICHAEL F. GUYER, of the University of Cincinnati, has been appointed professor of zoology in the University of Wisconsin.

PROFESSOR J. A. FERGUSON, of the Pennsylvania State College, has been appointed professor of forestry in the College of Agriculture of the University of Missouri. The College of Agriculture owns fifty thousand acres of forest lands in the southern part of Missouri. It is planned to utilize these lands as an out-door laboratory for the instruction in practical forestry.

FRANK LOXLEY GRIFFIN, Ph.D. (Chicago), assistant professor of mathematics at Williams College, Williamstown, Mass., has been appointed professor of mathematics at Reed College, the new institution at Portland, Ore., which is to open September 18, 1911.

THE REV. ALAN S. HAWKESWORTH has resigned from a lectureship in higher mathematics and semitic languages in the University of Pittsburgh.

PROFESSOR GEORGE D. HUBBARD, head of the department of geology at Oberlin College, has charge of the work in geology and geography at Ohio State University during the summer session.

W. H. LONGLEY, Ph.D., instructor in biology in Yale University, has been appointed assistant professor of biology in Goucher College.

WILLIAM CUMMING ROSE, Ph.D., formerly assistant in the Sheffield Scientific School, Yale University, has been appointed assistant instructor in physiological chemistry at the University of Pennsylvania.

DISCUSSION AND CORRESPONDENCE

DOUBLE MATING OF SILK-WORM MOTHS

IN SCIENCE for May 19, 1911, Professor Kellogg reports certain double mating experiments with silk-worm moths, of which he invites criticism. His account leaves one with the general impression of a "perturbation in the order of inheritance" due to the presence of spermatozoa furnished by two different males. Several possible explanations are suggested by Kellogg, none of which however is advocated. For example, he inquires:

> Do the eggs in double-mated females receive more than one spermatozoon and are these spermatozoa often the representatives of both races used in the double mating? Or can the egg be in any way influenced by the mere presence in the spermatheca of spermatozoa representing both of a pair of allelomorphic heritable characters? Can fluids carrying the spermatozoa have any influence during fertilization? Can the spermatozoa of one type influence those of the other type during their enforced companionship for several hours or days in the female spermatheca?

Admitting that our present knowledge would lead us to answer these various questions in the negative, Kellogg closes with the inquiry:

> Then why should the order of inheritance in the silkworm moth be different in the generations after these double matings from the order in the generations following a single mating?

But is it? I think not. And since it would seem to be of doubtful wisdom to seek possible explanations for a fact which is not true, let us first make sure of the fact.

Kellogg presents his data without any attempt at analysis, and this fact I think has led him, as it naturally does the reader, to suppose that the ordinary Mendelian inheritance of cocoon color is in these matings much disturbed. Before any critical discussion of the data is possible they must first be classified. Comparison may then be made with the behavior of the same races in *single* matings, which Professor Kellogg himself has given us in part in his 1908 paper.

In agreement with Coutagne (1902) and Toyama (1906), Kellogg finds that the inheritance of cocoon color in silkworms follows in general the Mendelian laws of dominance and segregation. Yellow color usually dominates over white in crosses, but in the case of certain races the dominance is not uniform. Yellow dominates over white in part of the zygotes only, in the remainder white dominates over yellow. This fact was first observed and clearly recorded by Coutagne (1902), who, though at that time unacquainted with the Mendelian laws, presented clear and convincing evidence of their applicability in the cases studied by him. Discussing Coutagne's results in 1905[1] I pointed out the fact (which Kellogg seems to have overlooked) that in cases where yellow dominates in F_1, there occur in F_2 three yellows to one white, whereas, when white dominates in F_1, there occur in F_2 three whites to one yellow. In other words the character which behaves as dominant in F_1 continues to behave as dominant in F_2. Kellogg's experiments show this same result both in single and in double matings, as I shall presently point out.

It happens that Kellogg has used in his double mating experiments a white race (Bagdad white) which is sometimes dominant,[2] sometimes recessive in crosses with yellow, and this seems to have been the real reason why he thought the "inheritance perturbed" by double mating. As a matter of fact the perturbation is no greater in the double than in the single matings.

In 1908 Kellogg reported the results of six crosses of Bagdad white with Istrian yellow, which were carried through two generations, as shown in Table I. One of the seven original matings produced only yellow offspring, two produced only white, and four gave a mixed progeny consisting of 82 whites and 60 yellows. Six matings of F_1 yellows *inter se* produced in F_2, 117 whites : 350 yellows, or 1w : 3y. Six matings of F_1 whites *inter se* produced in F_2, 418 whites : 140 yellows, or 3w : 1y. In both cases, it will be observed, the character which dominated in F_1 was in F_2 approximately three times as numerous as the other, a consistent Mendelian behavior. Further, when white dominant in F_1 was mated with yellow dominant in F_1, the result was the production of both sorts in numbers approximately equal. Seven such matings produced, in F_2, 324 whites and 381 yellows, or 1w : 1.2y.

---

[1] Carnegie Institution Publication, No. 23, p. 59.

[2] Kellogg expressly recognizes (p. 784) the frequent behavior of Bagdad white as a dominant character in crosses with yellow in single matings, yet on page 788 makes the surprising statement: "After a double mating the whites of the F_1 generation mated with other whites of the same generation do not always produce whites. They may produce both yellows and whites." [Certainly! If white is dominant, it should behave in just that way.] Kellogg then continues: "Or this latent carrying of the yellow character by these presumably strictly recessive (white) carriers may not be manifest till an F_3 generation." Kellogg then proceeds to seek an explanation in the double mating of the mother, having forgotten apparently his express statement on page 784 that Bagdad white frequently behaves as a *dominant*, which fact would explain everything.

TABLE I. RESULTS OF SINGLE MATINGS OF BAGDAD WHITE WITH ISTRIAN YELLOW SILKWORM MOTHS

F_1		F_2		
White	Yellow	Parents	White	Yellow
31	21	W × W	57	31
		W × W	51	18
		Y × Y	34	86
		Y × Y	7	42
		W × Y	26	40
		W × Y	36	29
10	9	Y × Y	11	26
		W × Y	54	56
		W × Y	67	45
all	0	W × Y[1]	41	66
31	21	W × W	85	26
10	9	W × W	86	33
		Y × Y	13	71
		W × Y	48	72
		W × Y	52	73
all	0	W × W	77	17
		W × W	62	15
0	all	Y × Y	24	64
		Y × Y	28	61
Summary		*6*W × W	*418*	*140*
		*6*Y × Y	*117*	*350*
		*7*W × Y	*324*	*381*

In double matings of these same races there is only this difference to be borne in mind; the egg may have been fertilized *either* by a sperm of the same race or by one of the other race. In the former case we should expect the F_1 individuals all to be like the mother, and *all to breed true in F_2*, whereas in case of a cross we should expect F_1 sometimes and F_2 always to consist of a mixed brood.

Kellogg reports six such double matings (Tables II. and III.), three of which gave all yellow F_1 broods (except for a single possible "straggler"); one mating gave only white F_1 offspring, while two gave both sorts in F_1. Seven pairs of F_1 whites (from a Bagdad white mother, Table II.) gave only whites in F_2 as well as in F_3. Clearly the egg of the Bagdad mother was in each of these cases fertilized by sperm of the same race. At any rate the behavior through three generations is exactly the same as in the pure Bagdad race and shows no "perturbation" whatever.

One other mating of F_1 whites *inter se* gave in F_2, 46 whites : 15 yellows, or 3w : 1y, as we should expect the white F^1 individuals to do when produced by a *single* mating between the white and the yellow races used.

TABLE II. RESULTS OF MATING BAGDAD WHITE FEMALES DOUBLY, VIZ., WITH BAGDAD WHITE AND WITH ISTRIAN YELLOW MALES

F_1		F_2			F_3		
White	Yellow	Parents	White	Yellow	Parents	White	Yellow
15	57	W × W	11	0	W × W	all	0
		W × W	all	0	W × W	all	0
		W × W	all	0	W × W	all	0
		Y × Y	6	22	W × W	35	0
					Y × Y	0	24
		Y × Y	9	20	W × W	25	0
					Y × Y	12	21
		Y × Y	4	17	Y × Y	8	20
		W × Y	12	12	W × W	19	0
					Y × Y	10	17
		W × Y	16	20	W × W	6	0
					Y × Y	8	6
					W × Y	4	12
		W × Y	5	31	W × W	19	0
					Y × Y	0	9
41	0	W × W	59	0	W × W	all	0
		W × W	all	0	W × W	all	0
		W × W	46	15	W × W	all	0
					Y × Y	0	all
48	20	W × W	all	0	W × W	all	0
		W × W	all	0	W × W	all	0
		Y × Y	9	12	W × W	all	0
					Y × Y	0	all
		Y × Y	1	26	Y × Y	2	14
		Y × Y	12	28	W × W	15	1(?)
					Y × Y	0	50
		W × Y	40	16	W × W	28	29
					Y × Y	5	34
		W × Y	20	19	W × W	70	0
					Y × Y	6	9
0	29	Y × Y	8	25	W × W	all	0
		Y × Y	6	12	W × W	all	0
					Y × Y	6	9
		Y × Y	9	30	Y × Y	0	all
		Y × Y	4	19	Y × Y	5	29
Summary		*7*W × W	*all*	*0*	*7*W × W	*all*	*0*
		*1*W × W	*46*	*15*	*1*W × W	*all*	*0*
					*1*Y × Y	*0*	*all*
		*10*Y × Y	*68*	*211*	*6*W × W	*all*	*1(?)*
					*5*Y × Y	*33*	*93*
					*4*Y × Y	*0*	*all*
		*5*W × Y	*93*	*98*	*4*W × W	*all*	*0*
					*1*W × W	*28*	*29*
					*1*Y × Y	*0*	*9*
					*4*Y × Y	*29*	*66*
					*1*W × Y	*4*	*12*

---

[1] From F_1 of last cross in Table I.

TABLE III. RESULTS OF MATING ISTRIAN YELLOW FEMALES DOUBLY, VIZ., WITH ISTRIAN YELLOW AND WITH BAGDAD WHITE MALES

F_1		F_2			F_3		
White	Yellow	Parents	White	Yellow	Parents	White	Yellow
1(?)	55	Y × Y	10	23	Y × Y	2	12
		Y × Y	13	28			
		Y × Y	10	24	W × W	4	0
					Y × Y	16	0
0	30	Y × Y	4	16			
		Y × Y	4	19			
Summary		5Y × Y	*41*	*110*	*1*W × W	*all*	*0*
					*1*Y × Y	*2*	*12*
					*1*Y × Y	*all*	*0*

Fifteen matings of F_1 yellows *inter se* (Tables II. and III.) gave in F_2 109 whites : 321 yellows, or 1w : 3y, exactly as in the corresponding generation following *single* matings of the same races.

Five matings of F_1 white with F_1 yellow (Table II.) gave 93 whites : 98 yellows, close equality of the two sorts, again *as in the single matings.*

Thus far we have no evidence of any departure in the double matings from Mendelian inheritance as strict as prevails in the single matings. If such departures occur they are to be found in the remainder of Kellogg's statistics, which are based on F_3 matings. No F_3 broods from single matings of the races under consideration are reported by Kellogg. Surely he has not overlooked the elementary fact that F_3 matings should on a Mendelian expectation produce a different result from the F_2 ones, yet on no other supposition can I account for the fact that Kellogg speaks of "irregularities" that occur with "non-Mendelian regularity." These "irregularities" of F_3 as compared with F_2 are not "non-Mendelian"; they are part of the Mendelian expectation as a moment's consideration will show. The F_1 individuals, whether yellows or whites, produced by a (single mating) cross of yellow with white are all heterozygous and so are expected to produce mixed broods, but of the F_2 individuals only *part* are heterozygous. The F_2 yellows from F_1 yellow pairs should be two thirds of them heterozygous like the F_1 yellows, but one third of them should be homozygous and so capable of producing all yellow broods. The same would be true also of the F_2 whites.

Kellogg reports seventeen matings *inter se* of F_2 yellows derived from F_1 ancestors, one or both of which were yellows. Six of these matings produced only yellow progeny indicating that the pair contained at least one homozygous yellow individual. One of the matings produced only white progeny, a surprising result if it is not a misprint. The remaining ten matings produced mixed broods, like those of the F_2 generation, aggregating 64 whites : 171 yellows, or 1w : 2.7y, a slight deficiency of yellows but no greater than the expected Mendelian deviations from the exact 1 : 3 ratio.

Let us now consider what is to be expected regarding F_2 whites mated *inter se.* If the egg of a Bagdad white female were fertilized by sperm of a Bagdad white male, we should expect F_1 and all subsequent generations from such fertilizations to contain only white individuals. Seven F_3 broods (Table II., summary) fall in this category as previously noted, being derived from seven different F_1 pairs coming from white F_1 pairs produced by a white mother doubly mated, but as regards these eggs evidently purely fertilized. These seven pairs produced only white offspring both in F_2 and in F_3.

In case the Bagdad white egg were fertilized by yellow sperm and gave yellow F_1 individuals which produced mixed broods, and white individuals from these broods were mated *inter se,* we should expect them to produce only white offspring, white being the recessive character in such cases and so presumably pure. Six of the F_2 white pairs (Table II.) fall in this category and produce only white F_3 offspring, except for one individual possibly a yellow "straggler," as suggested by Kellogg.

In case the F_2 white individuals were derived from a *crossed* (and so *dominant*) white F_1 individual mated with a yellow one likewise a dominant heterozygote, we should expect such F_2 whites to be in part heterozygous, but in larger part homozygous, and of these homozygotes some should be *dominant* whites. Now a homozygous dominant white individual, however mated, should produce only white offspring, and only occasionally would a *pair* of *heterozygous* dominant whites be secured, the condition necessary to allow yellow to recur in F_3. But we must remember that *homozygous* whites as well as heterozygous ones occur in F_1. Therefore matings of F_1 whites selected at random with yellows all known to be heterozygous should produce in a probable majority of cases white F_1 progeny which would be homozygous. Two of these mated together should, of course, breed true in F_3. Accordingly we expect pairs of F_2 whites in most cases to produce only white F_3 offspring. Kellogg records five F_2 matings of whites from white × yellow F_1 pairs (see Table II.). Of these, four produced only white F_3 individuals but one produced a mixed brood of 28 whites and 29 yellows.

Let us next consider what is to be expected from yellow × yellow F_2 pairs derived from white × yellow F_1 parents. The F_1 whites, as we have seen, are often homozygous. Therefore F_2 yellows descended from them are pretty sure to be heterozygous and should in general produce mixed broods. Kellogg records five such matings (see Table II.), four of which gave mixed broods aggregating 29 whites : 66 yellows, or approximately 1w : 2.3y. The fifth brood produced 9 offspring, all yellow. From so small a number it is impossible to decide whether one or both parents were homozygous in yellow, as seems probable. It is evident, however, that the great majority of the F_2 yellows of this origin are, as expected, heterozygous.

Finally mention should be made of a mating of F_2 yellows derived from white F_1 parents, which produced only yellow young in F_3. This seemingly contradictory result exactly accords with Mendelian expectation, for in this cross yellow was *recessive* in F_1, therefore upon reappearing in F_2 it should be *homozygous* and so breed true.

At every point, in this series of experiments, the Mendelian expectation is realized, not only in F_2, but also in F_3, if we base that expectation on the behavior of the same races in the single matings made by Kellogg. It is therefore idle to seek for explanations of "perturbed inheritance" due to double matings where no perturbation is discoverable.

In a second series of double matings made by Kellogg, the same white race (Bagdad) was employed together with "French yellow." In three matings (Table IV.) the French yellow female was used, and in the same number of cases (Table V.) the Bagdad white female was used. In each case the female was mated both with a male of her own race and with

TABLE IV. RESULTS OF MATING FRENCH YELLOW FEMALES DOUBLY, VIZ., WITH FRENCH YELLOW AND WITH BAGDAD WHITE MALES

F_1		F_2			F_3		
White	Yellow	Parents	White	Yellow	Parents	White	Yellow
57	74	Y × Y	8	22	W × W	all	0
					W × W	all	0
					Y × Y	0	all
					Y × Y	9	20
		Y × Y	5	14			
		Y × Y	2	23			
		W × Y	19	17	W × W	26	12
					W × W	19	6
		W × Y	17	21			
14	140	W × W	30	10	W × W	62	0
		W × W	20	10	W × W	"some"	"some"
					Y × Y	2	12
		Y × Y	2	18	Y × Y	1	4
		Y × Y	0	59	Y × Y	0	47
		W × Y	18	14	W × W	29	11
					Y × Y	3	1
		W × Y	10	10	W × W	93	25
					Y × Y	8	35
0	90	Y × Y	3	13	Y × Y	0	all
		Y × Y	8	17	Y × Y	6	10
Summary		*2*W × W	*50*	*20*	*1*W × W	*all*	*0*
					*1*W × W	*"some"*	*"some"*
					*1*Y × Y	*2*	*12*
		*6*Y × Y	*28*	*107*	*2*W × W	*all*	*0*
					*2*Y × Y	*0*	*all*
					*3*Y × Y	*16*	*34*
		*1*Y × Y	*0*	*59*	*1*Y × Y	*0*	*47*
		*4*W × Y	*64*	*62*	*4*W × W	*167*	*54*
					*2*Y × Y	*11*	*36*

one of the other race, as in the crosses with Istrian yellow.

In one case the French yellow mother produced only yellow offspring. This was evidently due to complete dominance of yellow in the cross, for white descendants were obtained both in F_2 and in F_3. In the two other broods produced by French yellow mothers, both white and yellow individuals occurred in F_1, so that dominance here alternated between yellow and white.

The reciprocal cross (Bagdad female × French yellow male, Table V.) gave a similar result. In one case, white was completely dominant; in the other two, mixed broods were obtained.

TABLE V. RESULTS OF MATING BAGDAD WHITE FEMALES DOUBLY, VIZ., WITH BAGDAD WHITE AND WITH FRENCH YELLOW MALES

F_1		F_2			F_3		
White	Yellow	Parents	White	Yellow	Parents	White	Yellow
all	0	W × W	111	44	W × W	all	0
					Y × Y	8	40
					Y × Y	9	29
		W × W	all	0	W × W	all	0
					W × W	15	2
		W × W	all	0	W × W	14	0
					W × W	17	4
25	13	W × W	1:	1	W × W	all	1(?)
					Y × Y	1	a few
		W × Y	1:	1	W × W	23	2
33	19	W × W	all	1(?)	W × W	all	0
		Y × Y	1:	1	W × W	9	1
		W × Y	22	0	W × W	a few	0
		W × Y	6	10	Y × Y	1:	1
Summary		*3*W × W	*all*	*1*(?)	*3*W × W	*all*	*0*
					*2*W × W	*32*	*6*
		*2*W × W	*111*	*44*	*2*W × W	*all*	*1*(?)
					*1*Y × Y	*1*(?)	a few
					*2*Y × Y	*17*	*69*
		*1*Y × Y	*1:*	*1*	*1*W × W	*9*	*1*
		*1*W × Y	*22*	*0*	*1*W × W	*a few*	*0*
		*2*W × Y	some	some	*1*W × W	*23*	*2*
					*1*Y × Y	*1:*	*1*

F_1 yellows from a French yellow mother were mated *inter se* in seven cases. One of the seven pairs produced only yellow F_2 offspring, 59 in number, and a pair of these gave, in F_3, 47 offspring all yellow, which result indicates that one or both of the F_1 yellows in this case were pure, being derived from a fertilization by sperm of the French yellow male. The remaining six pairs of F_1 yellows produced mixed F_2 broods aggregating 28 white : 107 yellow, or 1w : 3.8y, a small excess of yellows. Four matings of F_1 yellows with whites (Table IV., summary) produced mixed broods, aggregating 64 whites : 62 yellows, or 1w : 1y, as in similar matings (single or double) of Bagdad with Istrian yellow. Two matings of F_1 (dominant) whites from a French yellow mother (Table IV.) produced 50 whites : 20 yellows, where 3w : 1y are expected. In the reciprocal cross (Table V.) F_1 whites produced in two cases white offspring only and in a third case all white but one individual, a possible straggler, while two other pairs gave mixed F_2 broods. In case of the two F_1 pairs which produced only white F_2 offspring, it is evident that only one of the white parents can have been pure (derived from a white × white fertilization), for yellows were obtained in F_3 in three of the four matings made. Matings of F_1 whites with F_1 yellows were made in three cases, two of which produced mixed broods of approximately 1w : 1y; in the third mating the white was apparently pure (from a white × white fertilization), for the 22 F_2 offspring were all white, as were also the "few" F_3 offspring descended from them.

So far there is encountered nothing at variance with Mendelian expectation. But among the F_3 broods derived from this cross (Table V.) occur some minor irregularities. However, the numbers in these broods are in general very small, so that this part of the series can not be regarded as very satisfactory. The chief irregularity occurs among the F_3 progeny of a cross which had given whites only in F_1 and 111w : 44y in F_2, a consistent behavior of white as dominant. A pair of the F_2 whites produced an all white F_3 brood, also a consistent result, but two pairs of the F_2 yellows produced *mixed* F_3 broods, viz., 17w : 69y where we should have expected only yellow progeny in accordance with the *recessive* behavior of yellow in the two previous generations. (Compare the reciprocal cross,

Table IV., where this expectation is realized.) Dominance here has apparently shifted from the white to the yellow character. It would be a matter of great interest to know how the character would behave in later generations and whether the altered dominance may not be due to some independent factor interchangeable between white and yellow. We get no evidence of such a condition elsewhere in Kellogg's experiments, and the numerical proportions of the yellows and whites in these two broods are a slender basis on which to base such a hypothesis, but these two broods would form a good starting-point in looking for an explanation, if they were followed into later generations.

Kellogg's experiments seem to the writer to be of value not in respect to their double mating feature, which really has produced nothing at variance with the results of single matings, but in their demonstration, in common with Coutagne's experiments, of varying dominance, a matter as yet quite obscure and affording inviting material for further study. It is to be hoped that Professor Kellogg will not fail to put on record the further data mentioned in his paper.

W. E. CASTLE

BUSSEY INSTITUTION,
HARVARD UNIVERSITY,
June 7, 1911

WHAT IS WHITE AND BLACK ALKALI?

THE popular distinction between "white" and "black" alkali salts in soils is of considerable practical importance, and anything that tends to confuse the farmers' ideas in this respect is regrettable; doubly so when official publications of experiment stations or the Department of Agriculture at Washington lend countenance to such confusion. The cultivation and reclamation of lands affected by alkali salts is comparatively simple when the alkali is "white," but always more risky and difficult when these are "black," and in the latter case are sometimes economically impracticable.

In a general way, black alkali is sodium carbonate, which after dissolving the humus of the soil, leaves black spots on the land where the solution has evaporated; while white alkali leaves only the white crust of the sulfate and chloride of sodium. Broadly speaking, the sulfate is quite four times less injurious to vegetation than the carbonate, while common salt stands in between in this respect.

Some years ago, it was stated in an official publication, that an observer had "discovered" that bicarbonate (hydrocarbonate) of sodium was frequently present in alkali salts; and as laboratory experiments had shown that the bicarbonate was not more injurious than the other two "white" salts, it should, therefore, be considered as part of the latter. And having been the first to investigate alkali lands in this country, I have been censured for overlooking such obvious facts, giving lands containing the bicarbonate an undeserved bad name.

Now any one familiar with the occurrence and behavior of the three sodium carbonates —the normal or monocarbonate, the sesquicarbonate (so-called) or trona, and the hydro- or bicarbonate, can readily understand the reason why I have considered the presence of either of these compounds in the soil equivalent to that of the others. The only one of them that occurs as a mineral in nature, and is stable under natural conditions, is the sesquicarbonate, occurring as trona wherever a solution of either of the other two evaporates spontaneously in the presence of atmospheric air. The monocarbonate absorbs carbonic dioxide from the air whenever exposed, so that when we want to obtain an accurately weighed quantity of the normal carbonate, we must first ignite it. On the other hand, the bicarbonate begins to lose carbon dioxid as soon as exposed to moist air, and upon evaporation its solution leaves a residue of sesquicarbonate, which acts practically as though it contained the normal carbonate, in dissolving humus, causing injury to vegetation, and puddling the soil.

It is thus obvious that, supposing a soil to contain a solution of bicarbonate only, the latter will, so soon as it is raised to the sur-