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ANIMAL MECHANICS.[1]

BY DR. MANLY MILES.

Reference was made to a former lecture before the Michigan Short-horn Cattle Association, in which the relations of heredity and variation to the improvement of live stock were discussed, and attention was called to the flexibility of the constitution of domestic animals that made them susceptible to the modifying influences of the conditions in which they are placed—so that variations are constantly produced by changes in food and management, and constant care must be exercised to select the animals presenting desirable variations to fix and retain them as inherited characters.

In presenting these fundamental principles in the improvement of animals, many important details were necessarily omitted, and at the present time my purpose is to supplement the general subject of heredity and variation, by calling attention to some of the latest contributions of science to the philosophy of feeding, and notice their relations to the principles of selecting breeding stock, that are often overlooked by inexperienced breeders in their efforts to improve their animals in special qualities.

In the lecture referred to, animals were compared to machines for converting the vegetable products of the farm

[1]Abstract of a lecture before the Michigan Association of Breeders of Improved Live Stock, Dec. 17, 1892.

into animal products of greater value. This simile, which is often made, is of greater significance than at first sight would appear, and if breeders will keep in mind the fact that they are, in effect, providing machines for doing work in the manufacture of meat, milk, wool, muscular power, or other animal products, from the raw materials derived from the soil, the means of improvement will be more readily understood.

From this point of view the breeders of live stock should have a deep interest in the general progress of agriculture, as any improvement in crop growing must be to their advantage, from the larger supply of raw materials for the manufacture of animal products, which should increase the demand for animal machines to perform the work with the greatest economy, and at the same time turn out a finished product of a quality than can be disposed of at renumerative prices in the market.

This simile of a machine makes apparent the fallacy of the old notion that the animal that eats the least is the best for the farmer. It would certainly be a poor recommendation for a machine to say that it could work up but a small amount of raw materials. The object of the farmer is, profit, and in every department of production the aim should be to obtain the largest net return from the raw materials he has to dispose of. The more the animal machine can do of useful work, the greater its value to the farmer, if the results are obtained with the greatest economy.

Another popular error will be readily corrected by looking upon animals as machines for doing work. The notion has too generally prevailed that animals are composed simply of flesh and blood and bones, etc., and that when they are furnished with food containing the materials which enter into the composition of their tissues, it would, in some mysterious way, be converted into animal substances. This is, however, a partial or one-sided view, that does not represent the whole truth.

Farmers are constantly dealing with the forces of Nature, and a knowledge of natural laws cannot fail to aid them in their mastery. The applications of the law of the conservation of energy to animal and vegetable physiology, which have recently been made, are of great assistance in giving clear and correct notions in regard to the economy of living beings, and we learn that the materials used in the constructive processes of plants and animals are not of greater importance than the motive power required to convert them into living substances.

The law of the conservation of energy has revolutionized modern physics, and the industries have been directly benefited by its applications, and its influence in agriculture when rightly applied, can hardly be overestimated. Faraday pronounced it "the highest law in physical science which our faculties permit us to perceive," and it has been claimed to be the most important discovery of the present century.

Energy has been defined as "the power of doing work, or overcoming resistance." Its familiar manifestations we call heat, light, motion, electricity, etc. These different forms of energy are mutually convertible, without gain or loss, or, in other words, the energy of the Universe is a constant quantity that is neither increased or diminished by the transformations it undergoes.

All forms of energy may be transformed to heat, and this furnishes a convenient unit or standard for measuring it. The unit of heat is the amount required to raise one pound of water one degree in temperature. Its mechanical equivalent is 772 foot-pounds, which is the unit for measuring work. That is to say, the heat required to raise one pound of water one degree in temperature, is equivalent to the force required to raise a weight of one pound 772 feet, or a weight of 772 pounds one foot, which is, conveniently expressed, as 772 foot-pounds, the weight in pounds being multiplied into the distance in feet through which it is raised. Foot-pounds divided by 2000 will give the result in foot-tons, which is often used.

When a weight of one pound is raised 772 feet, it represents, in that position, 772 foot-pounds of potential, or stored energy, and when this weight is allowed to fall the entire distance without interruption, the stored energy is transformed into active energy or motion, and when this motion is arrested on completion of the fall of 772 feet, heat is liberated sufficient to raise one pound of water one degree in temperature, or, the equivalent of the energy required to raise the weight to the height from which it fell. This serves to illustrate what is meant by the conservation of energy.

The transformation of food constituents into animal subtance involves the performance of work by the animal machinery of nutrition, which is carried on at the expense of the stored energy of the food consumed. An expenditure of energy in work is as necessary to convert corn or grass, into animal subtance, as in the hauling of a load on the road, and the term work is as applicable, in the same sense, in the one case as in the other. Sheep growing wool, cows giving milk, and animals fed for the butcher, should, therefore, be recognized as working animals, as well as those used in draft, or in lighter, more rapid work on the road.

Internal work must be done in the first place to convert vegetable substances into animal substance; and, in the next place, an additional amount of work must be done in the further conversion of animal substance into the special animal products of meat, milk, wool and muscular force, which are the real sources of profit in feeding. Moreover, this internal work involves the wear and tear of the animal machine, which unlike purely mechanical devices, makes its own repairs at the expense of the raw materials it is its mission to convert into animal products.

An important question here presents itself; how is the food consumed by animals disposed of, and what purpose does it serve in the animal economy? The correct answer to this is of great practical importance and interest to every farmer, and especially to breeders of improved stock.

In the first place, materials are provided for growth, and for the needed repairs of the system, but only a small proportion of the food constituents are utilized for these purposes, as will be seen from the following table giving the results of experiments at Rothamsted.

Each 100 pounds of food constituents consumed by fattening animals were disposed of as follows:

Constitutents of Food. 100 lbs. each.	Stored in increase.			Voided in Excreta.		
	Oxen.	Sheep.	Pigs.	Oxen.	Sheep.	Pigs.
	lbs	lbs	lbs	lbs	lbs	lbs
Proteids	4.1	4.2	13.5	95.9	95.8	86.5
Non-proteids	7.2	9.4	18.5	14.1	8.9	4.1
Minerals or Ash	1.9	3.1	7.3	98.0	97.0	92.7
Dry Substance	6.2	8.0	17.6	36.5	31.9	16.7

The food constituents not accounted for have served a useful purpose in their liberated energy for the performance of work, and their residues have been exhaled in the gaseous form, and the surplus energy as animal heat. Growing animals, and cows giving milk, will retain, or utilize a larger proportion of the food constituents, but even then much the larger part of the material elements of the food are discharged in the excreta.

In the next place, the potential or stored energy of the food is made available in all of the work done by the system, and it is the sole source of power in all of the processes of the animal machine.

From the prominence given to the chemical theory of nutritive ratios in some of our agricultural papers, farmers are asked to believe that success in feeding depends upon following certain theoretical formulas, giving the proportions of food constituents in the rations fed, while the animal machine which does the work of manufacturing valuable animal products, and the motive power that makes it efficient, are entirely ignored. I can only say in passing, that in the present state of knowledge, we cannot formulate the constituents of foods in chemical terms, to serve as practical guides in feeding. The machine itself, is the most important consideration, and its capacity, for doing the work required of it, is of far greater significance than the proportions of the comparatively small amount of the so-called nutritive constituents stored up, or used by the animal.

Let us for a moment consider the facts in regard to the construction and repair of other farm machinery, as reapers, mowers, threshing machines, etc. When we take an exact inventory of the items of cost, in the construction and repair of these machines, we find that the materials of which they are made, or are used in repairing them, make but a small figure in the expense account, and that the work done in shaping and fitting the materials in proper relations, represent a very large proportion of the real cost of the machine or of the repairs that may be made. In repairing a machine, a few cents may pay for the iron or wood used, while several dollars would be required to pay for the work done.

The same principle holds good with the animal machine, both in its original construction and its repairs. But a small proportion of the food constituents are utilized in the processes of nutrition, and a very large amount of energy is constantly expended in the work of transforming these materials into animal substance and animal products.

The real significance of these facts will best be seen by making a quantitative estimate of the energy expended, and the transformations it undergoes in organic processes, as represented in the following table giving an approximate statement of the composition of one acre of corn, and of a fat ox analyzed at Rothamsted.

	Constituents	Corn one Acre. 3360 lbs. grain, 3840 " stalks, 7200 lbs. total		Fat Ox. Fasted Live Weight, 1419 lbs. (Contents of Stomach, etc., 85 lbs.).	
		Per cent.	Lbs.	Per cent.	Lbs.
A	Carbon	39.7	2858	31.6	448
A	Hydrogen	7.0	504	9.7	137
A	Oxygen	48.8	3511	46.5	660
A	Nitrogen	1.3	90	2.4	34
A	Ash	3.3	237	3.9	55
A	Potash	1.10	79	0.18	2.6
A	Phos. Acid.	0.53	38	1.55	22
B	Water	17.1	1232	45.5	646
B	Proteids	7.8	562	14.5	206
B	Fat	3.3	237	30.1	427
B	Carbhydrates	68.5	4932		
B	Ash	3.3	237	3.9	55
B	Potash	1.10	79	0.18	2.6
B	Phos. Acid	0.53	38	1.55	22

Stored energy representing work done.	17,083,000 foot-tons, equivalent to the work of one horse continuously for 719 days.	3,381,000 foot-tons, equivalent to the work of one horse day and night for 142 days.

A chemical analysis of the corn shows (division A of the table), that it is composed of 2858 lbs. of carbon; 504 lbs. of hydrogen; 3511 lbs. of oxgen; 90 lbs. of nitrogen; and 237 lbs. of ash, or mineral constituents, the most important of which are potash 79 lbs., and phosphoric acid 38 lbs. The ash constituents and the nitrogen are alone derived from the soil.

We have here the elements of which the crop is composed, but division B of the table shows that they represent water 1232 lbs.; proteids 562 lbs.; carbhydrates 4932 lbs.; and ash 237 lbs. These are the facts furnished by chemistry in regard to the composition of the acre of corn, but they do not represent the whole truth.

To transform the simple elements of division A of the table into the complex organic compounds of division B, energy must be expended and work done, and the energy so used is stored up in the organic substances formed as an essential condition of their constitution. The amount of this stored energy is represented in division C of the table, and it is an important factor in the composition of the crop of corn, as it is one of the essentials in animal nutrition.

This stored energy of the corn does not, however, represent the total expenditure in the growth of the crop. Experiments show that for each pound of dry organic substance formed by the growing corn, about 300 lbs. of water will be exhaled, or thrown off by the plants in the form of vapor. To convert water into vapor involves an expenditure of energy, and this for the acre of corn would be approximately equivalent to the work of 24 horses for six months without intermission. Water is likewise evaporated from the soil as one of the essential conditions of fertility, and this calls for a further expenditure of energy, which under our climatic conditions may be estimated at about twice the amount expended in exhalation from the plants themselves. Taking all of these processes together, the energy expended directly and indirectly in Nature's invisible unobtrusive work of growing an acre of corn, must be equivalent to the work of 76 horses, day and night, for six months.

This energy is all derived from the heat and light of the sun. The importance of proper soil conditions to favor the required transformations of energy in the growth of the crop will readily be seen.

The motive power of the animal machine, in all of its processes of nutrition and growth, is derived exclusively from the stored or potential energy of their food, and we may ask how this energy is liberated and made available in the animal economy.

As the energy used in its construction is stored up by the plant as an essential condition of its constitution, any disintegration of its organic substance will liberate the stored energy in the form of heat. This may be brought about in several ways. 1.—The plant may be burned, and the heat produced represents its stored energy. 2.—Microbes feeding on organic substances tear them apart and liberate the stored energy in the form of heat. The heat produced in the familiar processes of fermentation and putrefaction, all of which are caused by microbes, is but the stored energy of the organic substances on which they feed. 3.—The digestive processes of animals involve a disintegration of the food constituents, and liberate their potential energy for use in the processes of animal nutrition.

Turning now to the table, for the composition of the fat ox, we find it represented in division A, as consisting of simple elements, and in division B the complex compounds built up from these elements are given. It will be seen that work has been done, and energy expended in transforming the simple elements of division A into the complex compounds of division B, and, as in the case of the corn, the estimated amount of this expenditure of energy is given in foot-tons, and horse power, in division C of the table.

The popular notion that the proteids, fat and carbhydrates of the corn are directly converted into the proteids and fat of the ox that eats them, (division B), does not take into account all of the factors concerned. We have seen that energy must be expended in work to convert vegetable substances into animal substances, and this energy can only be obtained by tearing apart the vegetable compounds through the processes of digestion, and liberating their stored energy. In this process the vegetable compounds of the food are resolved almost into their elements, and from these comparatively simple substances by means of the energy liberated, the proteids and fats of the ox are manufactured.

The complex animal substances thus formed are continually undergoing change. The wear and tear of the animal machine involves a disintegration of its organic substance, and its stored energy is liberated as heat. This may in part be used again in the processes of repair, but a large proportion leaves the body as animal heat.

As in the case of the corn, the stored energy (division C of the table), of the fat ox does not represent all of the energy expended in building up its organic substance. A constant process of repair has been going on to replace the waste resulting from the wear and tear of the system, which involves a continuous expenditure of energy—and the loss arising from the energy thrown off from the body as animal heat, (radiation), and expended in vaporizing the water exhaled from the skin, (perspiration), must be replaced at the expense of the stored energy of the food to keep the machinery of nutrition, in efficient activity.

The facts presented are sufficient to show that the transformations of energy are important factors in the economy of plants and animals, and that the materials of which they are composed cannot be looked upon as the sole subjects of interest in farm economy. The tendency to make the compounding of food rations the prominent subject for consideration, conflicts with the interests of the breeders of improved stock, and misleads the farmers who are induced to look upon it as the real source of profit. This reference to the subject of feeding is made with the two-fold purpose of calling attention to the fallacy of feeding experiments in which the chemical composition of foods is made the prominent or sole object of interest, while the importance of the improvement of the live stock of the farm is wholly ignored ; and to remind breeders that they are fully warranted in claiming that improved animals are entitled to the first place among the means of an improved agriculture, as machines for manufacturing the crops grown on the farm into marketable products.

The most serious obstacles to the progress of agriculture at the present time arise from the one-sided and misleading statements that are made in the name of science by those who have but a superficial knowledge of Nature's laws, and their intimate relations to farm practice. The experiment station reports, on the feeding of animals, fail to give a full statement of all of the factors that may influence the results, and too often the record is made to conform to hasty assumptions, or false theories, so that it is difficult to find a grain of truth in the mass of chaff that is scattered broadcast over the country.

As the remarkable progress made in other productive industries has been largely owing to improvements in machinery, so progress in agriculture must depend, to a great extent at least, upon the further improvement of the animal machines that are so essential to success in the business of farming, and we must look to the breeders of the pure breeds to accomplish this desirable object.

It will not answer to rest satisfied with the present high development of the pure breeds and their more general diffusion on the farms of the country, but the aim of every intelligent breeder must be to still further increase their useful qualities in special directions. Notwithstanding the decided superiority of the pure breeds over the average farm stock, there is still a wide margin for improvement, as there are good reasons for believing that even the best animals do not utilize more than one-half of the available energy of their food in useful work.

The largest profit can only be realized with animals that have the ability to consume and utilize in useful work, an amount of food considerably in excess of what is required in the needed repairs of the system. This involves severe work, and one of the first essentials to be considered is that of stamina and constitution, or, in other words, the capacity for hard work and powers of endurance, or the same qualities in this respect that all working animals should possess.

These qualities are largely determined by heredity, and selections for breeding purposes should be made with reference to these qualities in the ancestors. Good sanitary conditions must of course be maintained, to secure a continuance of robust health and an active performance of the normal functions of nutrition.

Prepotency.

Strength of constitution or powers of endurance must not be confounded with prepotency, or the quality of holding a preponderating influence in the act of reproduction. Many animals that are prepotent in transmitting their own qualities, are deficient in constitution, and their offspring lack that active and vigorous performance of the nutritive organs that is essential to stamina and powers of endurance in useful work. Prepotency arises from uniformity in the characteristics of ancestors for many generations, and these characters may or may not be desirable.

In the improvement of the pure breeds with their present high development of valuable qualities, an accumulation of slight variations must be the aim. We cannot expect to gain any wide departure from present characters at a single step. Progress can only be made by a succession of short steps, and their sum will represent the real advantage gained. Small items determine the difference between gain and loss in the present activity of the industries, and in agriculture we must recognize the importance of slight improvements in each detail of general management as the only available method of making real progress.

Breeding to a Type.

In making selections for breeding, an ideal type of excellence representing definite valuable qualities, should be strictly adhered to. This type, in all cases, should represent the highest development of characters that indicate the posession of the desired useful qualities. The form should be that which represents a special adaptation to the particular purpose in view. It is well known that the general form of animals is correlated with particular functions. The form of the roadster differs from that which is suited for heavy draft, and the type for rapid meat production is different from that giving the best results in the production of milk.

The law of correlation has, however, a further application. There is not only an adaptation of the general form to the kind of work that can best be done, but the different organs of the body have correlated relations that are quite as significant. An excessive activity, or development of one organ, or set of organs, diminishes the activity or development of the system in other directions. That is to say, the system has a capacity for utilizing a certain amount of energy, and if it is largely expended in one direction there is less to be expended for other purposes. If the tendency to lay on fat predominates, the milk producing functions must suffer a corresponding diminution, and severe muscular work will diminish the tendency to lay on fat, or produce milk.

To give permanency and uniformity to the ideal type that has been adopted, selections for breeding must be strictly confined to animals having the desired characters, within the limits of a distinct breed, or of a single family of a distinct breed. This is in effect establishing, or fixing, family characters in the particular breed. The constitution or physical stamina of the family type should not be lost sight of in attempts to secure other desirable characters, as on it will depend the efficiency and profitable exercise of the special functions that have been cultivated and fixed as family characters.

All coarseness should be avoided. Improvements in all breeds have been made by securing a greater refinement of the system, or in diminishing the proportion of coarse parts. Large bones, with apparent good reason, have been looked upon as an indication of imperfect nutrition, and as a general rule, to which there are few, if any exceptions, they are correlated with coarseness in other parts. The wear and tear of the animal machine is greater in such cases, and a larger expenditure of energy is required in its repairs.

INHERITED HABITS.

Aside from the general inherited habits of animals with which you are all familiar, as the tendency to early maturity, or the habit of milk production throughout the year, or in what is called the trotting instinct, there are inherited habits of the nutritive organs themselves which should not be overlooked.

Habits are cultivated and established by their systematic exercise, and the desirable habits of the nutritive organs can only be cultivated and maintained by their constant exercise, or, in other words, by liberal feeding, and the direction in which the liberated energy of the food is expended must, at the same time, be determined and promoted by cultivating the general and special habits of the system. If, for example, milk is a leading object, in connection with a liberal supply of food, from which energy is freely liberated through the inherited activity of the nutritive organs—a sufficient capacity of the udder and other organs concerned in milk production must be provided—and a dominant tendency to the expenditure of the available energy in the milk producing function must be kept up by gentle treatment and regularity in milking and feeding. Judgment and skill must be exercised and attention given to many details, all tending in the same direction, to give the desired bias to the energies of the system.

The application of general principles will be found a better guide in practice than any specific empirical rules, and the habits of the system developed by judicious exercise and cultivation, must be fixed by systematic selection as hereditary characters.

GENERAL PURPOSE ANIMALS.

We can only call attention to some of the principles already presented to illustrate this special subject. There is, undoubtedly, a greater difficulty in securing two qualities on a high plane of excellence, than to obtain an extraordinary performance in a single special direction.

Milk and meat production are not strictly incompatable, and a high degree of excellence may doubtless be obtained with both. Greater skill is, however, required to combine the two qualities and retain them for any time, than to obtain a high development of either of them alone. A certain balance, or equilibrium, in the expenditure of energy, must be secured in the general purpose animal, or there will be a tendency for some single quality to predominate.

A tendency to the expenditure of energy in one direction during the period of growth, and in another direction when maturity is reached, may be cultivated and fixed by heredity. This principle is an important one for consideration in breeding dairy stock. When a cow is giving milk the tendency, or inherited habit of the organs of nutrition, may be to expend the entire energies of the system in the milk producing function, and when she becomes "dry," the available energy may be expended in laying on fat. The difficulty is, however, to maintain a due balance of the two functions. If the fattening tendency predominates, the period of giving milk may be shortened and the activity of the function ultimately diminished. One of the best precautions against this is to retain in perfection the milking type in the general form of the animal, and to keep up the milk secreting function as long as possible by proper management. Constant care in the selection and treatment of the animals will be required to secure the most desirable balance between the two functions, and prevent a predominance of either.

Exercise as a Factor in Improvement.

From the general principles already noticed, it must be seen that the exereise of special organs, and of the general system, are necessary to secure the highest excellence in the working of the animal machine. We must keep in mind the fact that the exercise of an organ or group of organs, involves an expenditure of energy, and what is spent in one direction cannot be used in another, that is to say, that work performed by one organ diminishes the amount of energy to be expended in work by another. Judgment is, therefore, required to adopt the exercise, in a particular case, to the requirements of the system for a special purpose.

The general exercise of the muscular system is undoubtedly desirable in growing animals to secure the symmetrical development of all organs, or parts of the body. Even in the process of growth a bias, or tendency to the expenditure of energy in a particular direction may be encouraged. This is illustrated in the Palo Alto training of youngsters. Culture and heredity have given the remarkable development of the trotting horse, and early culture, or training, is now looked upon as one of the most encouraging factors in future improvement.

In the animal raised for meat production, early maturity is essential, and the tendency to flesh forming may be encouraged from birth. Exercise of the general system in the early stages of growth should tend to promote the development of muscle, or lean meat, and check the tendency to excessive fat production.

While recognizing the advantages of muscular exercise during growth, in promoting the formation of lean flesh, and a symmetrical development of the system as a whole, we must not overlook its unfavorable influence under other conditions. In the case of a cow giving milk, or in that of a fattening animal, muscular exercise must result in a diversion of energy from the work of milk production or flesh formation. Any considerable amount of muscular exercise by a cow giving milk must tend to diminish both the quantity and quality of the milk produced, or at least diminish the total amount of the solid constituents of the product.

Quality of Milk and Energy.

A large mess of milk may be produced with but a small quantity of solids, and a corresponding small expenditure of energy. The best milk contains very much more potential energy than poor milk, and it must cost a corresponding expenditure of energy to produce it. In other words, more work is done by the animal machine in making good milk than in turning out an inferior article containing a larger proportion of water.

Sex Influencing the Transmission of Hereditary Characters.

From the manner in which pedigrees are recorded in some of the herd books, there is a tendency to overlook the characteristics of the female ancestors, which, especially in the dairy breeds, are of great importance. In the chapters on "atavism," and "the relative influence of parents" in my "Stock Breeding," a number of cases are collected showing that sex has an influence on the transmission of characters. A sexual alternation in the inheritance of dominant characters is often observed, female peculiarities being more strongly transmitted to male offspring, which they in turn impress upon their female offspring; and male characters are in the same way transmitted by females. This should not be overlooked in breeding dairy stock, as the milking qualities of the grand dam frequently appear to be transmitted to her grand daughters with greater intensity, and certainty, by her sons than by her daughters. The female ancestors of the bull in a dairy herd must, therefore, be of especial interest in his pedigree, as an index of the qualities he will be likely to transmit as dominant characters to his daughters.

The means of improving animals in useful qualities may be expressed in a few general principles, and the success of the breeder will depend upon their judicious application under the circumstances presented in each particular case, and every detail of practice must conform to them to secure the best results.

The most valuable qualities of our domestic animals are the outcome of highly artificial characters, representing a wide departure from the original stocks from which they sprung; and if the same artificial conditions that produced them are not maintained, and the selection of breeding stock is not limited to the animals that have the desired characters, they are readily impaired and finally lost. The old race characters, under careless management, have an advantage over the more unstable acquired characters that give the animal its greatest value.

Pedigrees must be studied to ascertain whether all ancestors have had the desired qualities. Cross breeding, in the widest sense of breeding together animals of distinct breeds, would not now be defended by any intelligent breeder, but the same principle is frequently acted upon in breeding together different families of the same breed, and unless there is a strong prepotency on the one side, the advantages of such crossing must be at least problematical.

Uniformity in hereditary characters, so far as we know, can only be secured by breeding together animals having the same characteristics.

The whole matter of successful breeding may be summed up in the two words "culture" and "heredity," and in the selection of breeding stock it is desirable that all ancestors should have had the required form of culture, or training, in order to secure uniformity in hereditary characters.

THE MEANING OF TREE-LIFE.

By Henry L. Clarke.[1]

(*Continued from Volume 28, page 472*).

It is a striking fact that the older fossil forest remains, at least through the Paleozoic and early Mesozoic strata, present a wonderful likeness in character the whole world over. The wide scattering and spreading of types that this indicates, is to be directly accounted for partly by the more frequent physical changes that took place in early geologic times, and the constant changes and shiftings in the relative positions of continental surfaces, through upheavals and subsidences; and in part by the wide wind-dispersion possible for the spores of the Paleozoic Cryptogams. Past question geology makes countless blunders in assigning strata in different parts of the world to the same age because of likeness in their fossil flora (and the statement holds almost equally true of fauna), where likeness is in fact a positive proof that the strata are not synchronous. But the chances for error in this direction decrease from the latest to the most remote ages. All evidences indicate more and more homogeneous climatic and physiographic conditions as we trace the geologic record farther and farther back.

When the low insular character of the early continents, and the consequent increased humidity of the atmosphere extended a nearly sub-tropical climate to the poles, it is obvious that the potency of the sun as a maker of the seasons and and zones, counted for far less than now,—unless indeed the sun itself were tremendously hotter then than now. But that this last supposition is false within the history of vegetation is proven by a simple fact. Were it true, the equatorial zone would have been a region of such intense heat that it would have formed an impassable barrier between the floras of the

[1]University of Chicago.

north and south polar regions; whereas, on the contrary, we find identical types to the far corners of both hemispheres.

It is a vitally important consideration that a slight increase in general atmospheric humidity would have the effect of converting the atmosphere into a heat-distributing oven.

We cannot indulge in the absurdity of asserting separate centers of identically similar development, and we know that the torrid zone of even the present would be impassable to perhaps 99% of our far north temperate flora; so here is proof sufficient of relatively great homogeneity in the conditions of the far past, and increasing heterogeneity thence down to the present. Aside from the greater stability and ruggedness of modern continents, the change that has wrought an all important effect upon vegetation, has been the development of the modern widely extended continental land-areas, producing a secular diminution in the general humidity of the earth's atmosphere, with the consequent full development of the great climatic zones, the polar, temperate, and torrid. Probably in the later Mesozoic and early Tertiary, this change began to make its influence most strongly felt, and through the Tertiary down to the present its effect has steadily and rapidly become more and more obvious. The fact is of course not to be lost sight of, that the highly specialized Mesozoic and Tertiary floras would be far more susceptible than the more lowly Paleozoic to climatic changes. But the working of these changes has been all-powerful in making most of the problems of geographic botany that are before us in the present, and so we may here fittingly turn the course of our discussion in this direction.

The progressive changes from the comparative homogeneity of conditions in remote ages to the world-wide heterogeneity of the present, have been recorded in the development of more and more complex tension systems between the various factors of vegetation. Of these systems, the most primitive was that belonging to each individual forest,—a central stronghold of old established types, merging into a tensional margin line of newer, weaker forms. Wherever vegetation existed, this tension system must have existed; but while we see it in the present world under an indefinite variety of aspects, probably in Paleozoic times a study of the tensions of one forest would have been, in the main, a study of all others. The far more homogeneous climatic and physiographic conditions then prevailing, must have meant almost as striking world-wide similarity between all forest tracts, as there is now bewildering diversity. New forms were far more rapidly dispersed from the localities where they originated, and wherever they migrated they found conditions practically similar and hence equally favorable. Thus within a comparatively brief range of time, closely similar floras might have been found in widely separated regions. But another factor came into play at an early period to greatly complicate the problem—the physiographic irregularities in continental surfaces. The increasing stability of physiographic features from remote toward modern times, has made these features vastly more complicated and diverse now than in ages past, and consequently their influence on vegetation has become more and more profound. The earliest, as well as all the subsequent manifestation of this influence, was the development of a second great system of tensions—tensions between the unlike vegetations of adjacent unlike country surfaces, between the swamp and the dryer plain, the flat country and the hills, the mountain sides and the valleys. Here the tensional margin lines of two diverse hosts of vegetation met and formed another tension line between their own, and on this, the struggle for the mastery waxed fiercest, and the evolution of highly specialized forms was most active.

Such were the two tension systems of preeminent importance in the early history of plant-life; later a third came upon the stage, brought into existence through the development of the great climatic zones. Probably this first began to assume decided importance, as has been pointed out, sometime in the later Mesozoic, and increased the range of its influence through the Cretaceous and Tertiary, till in modern times, it has culminated in producing the broadest and most fundamental division of the world into great botanical realms. That there were regions of glacial cold in Australia, India, and Cape Colony in Carboniferous times is an undoubted fact;

that there were regions of glacial cold in previous, as well as several subsequent, ages is highly probable; but this does not invalidate the general principle suggested here. The reconstructive meteorology of the near future will probably demonstrate that the geographical distribution ot the Carboniferous glaciation, and of several other similar cases, is directly connected with peculiar stages of continental evolution and oceanic extension. And while such glaciations are of far-reaching importance for their age, they are nevertheless temporary "perturbations" that do not, in the long range of time, break down the secular increase in the direct subordinating of the zonal world-climate to astronomical, rather than terrestrial, influences. From a nearly homogeneous climatic condition throughout the world, there were gradually developed five fairly distinct zones merging into each other at their adjacent margins—a torrid equatorial, frigid polar, and temperate intermediate. Their development inevitably had a profound effect on vegetation. In the fossil forest beds of Cretaceous times in far northern regions, there have been found side by side Cycads, Conifers, Palms and Hard-wood trees, a conglomeration utterly bewildering to the botanist of to-day, but nevertheless a typical indication of the relatively homogeneous climatic conditions of the age when such a forest could have existed.

With such a suggestion of the Mesozoic world before us, let us watch the great climatic zones develop. It is the tree-life of the forests that tells the story most clearly; to it belonged preeminently the all-important mission of remodeling the aspect of the world's vegetation. The trees moved their habitats, and the herbaceous forms were carried along with them. In the equatorial belt were all the conditions of heat and moisture most favorable to the vigorous development of plant life; in the polar regions that sternest foe, steadily increasing cold; in the temperate belts, a compromise between the conditions of the others. From the original mixed forest a selection had to be made of the tree-groups that were to hold dominion respectively over each of the new sets of conditions. How? It will not do to say glibly, the Palms loved the heat, the Conifers the cold, and the Hardwood trees the happy medium. Conifers luxuriate to-day in the torrid zone, and Hardwood trees and modern congeners of the Palms once grew together in Greenland. No innate partiality for heat or cold separated the three great groups, but the stern laws of plant dynamics that determine the course of the struggle for existence. The old established and all-powerful tree-group, the patriarchs of the forest, were the Conifers, the group best fitted to stem the tide of change and battle with opposing conditions; next them in power, because most like them in character, were the Diclinae; and weakest were the Palms, the group whose foot hold was most precarious. These last could hold their own against the powerful Conifers and Diclinae only so long as climatic conditions were most favorable. Consequently, as the cold advanced from the polar regions the palms retreated toward the torrid zone. Here they took their stand, their highly specialized structure asserted its full power, and gradually they crowded out the Conifers and Diclinae, and established preeminent dominion over the equatorial belt. The Diclinae and Conifers were crowded out, "not that they loved heat less, but that they loved freedom more." They were fitted to maintain themselves against the cold of extratropical regions, and in these regions they were relieved from the struggle with a powerful competitor, the whole family of Palms and its associated rank luxuriance of tropical vegetation. In short, the strength of the Palms when congested into the equatorial belt, more than counterbalanced the loss sustained by the coniferous and hardwood trees in the cooling of extra-equatorial regions. And so the Palms, and with them the remnant of their ancient allies, the Tree-ferns and Cycads, claimed the tropics for their heritage. There was probably no region of the world where Conifers had not gained a strong foothold in the long course of ages; there is scarcely a corner of the modern plant-world that does not hold some group of them; and it was the Coniferæ that obstinately held their own against the cold of sub-polar lands, with the stubborn endurance that four great eras of geologic time have helped to build.

The Diclinae retreated before the advancing cold into more temperate climes, retreated in fact until they gathered strength to wage equal battle with their mighty coniferous opponents.

Here, in the temperate zones, the Diclinae stood fast and crowded the Conifers outward toward the polar regions, not toward the equatorial, for there the odds againt the emigrants would be tenfold increased. The record of this battle of the trees is stamped upon many of the forest monarchs that we marvel at to-day. A recent writer has well said: "Just as in the formidable armor of some extinct armadillo one may read somewhat of its struggles with its enemies, so in the one hundred meters of solid trunk and in the massive girth of a living Sequoia gigantea, the giant red-wood, one may learn of its struggles in the ancient forests of Cretaceous and Tertiary times, when its allies and competitors were alike more numerous."

The third great tension system is now unfolded before us. We see the hardwood forests of temperate regions facing on the one hand the congested luxuriance of equatorial vegetation, and on the other the ancient coniferous forest gathered round the poles and step by step forced backward by advancing cold. There is a great equatorial pressure toward the poles, and an opposing polar pressure, traceable to opposite causes; and between them there is a broad tension line, the temperate zones. Conway MacMillan, who was quoted just above, has proposed a broadly generalized division of the world into two great botanical realms, the Central Realm and the Distal Realm. But the division should be carried a step farther; taking the three great forest elements as a guide, we may fully express the evolutionary history of plant dynamics by recognizing three great divisions:—

The Central Tropical Realm, the Tensional Temperate Realm, the Distal Sub-Polar Realm. The three merge into each other and their elements are everywhere somewhat commingled, but in the main they are fairly distinct. Such was the general plan of the plant world of the late Tertiary, proximate Preglacial times. The Glacial Period had a wonderfully interesting effect in modifying the northern portion of it. The story has been often told, but one aspect of it will deserve further attention. Out of the various forests of north temperate regions, we may recognize four that are of peculiar interest. The European, the Northeast Asian, the Appalachian, and the Pacific North American. All are relics of the preglacial northern forest, but they are relics in very different stages of preservation. The Northeast Asian is a marvel to students of tree-life in the abundance and immense variety of its forms. Evidently it has best preserved the characters of the primaeval forest. The poverty of the European forest is equally striking and has been well explained by the fact that the east and west mountain chains and the Mediterranean to the south were fatal to the vegetation retreating before the advancing glaciers. The Atlantic North American, or Appalachian forest, on the contrary, was well preserved by the physical characters of the country, and in its perfection is second only to the Northeast Asian. But the Pacific North American is an anomaly. It is preeminently a forest of Conifers with an astonishing poverty of hardwood types, although the latter are abundant as fossils in the Tertiary strata of the region. But is this such an enigma as it has often been considered? The ice sheet that swept over the Great Lakes and down into the Mississippi Valley did not reach that Pacific forest region of the United States, but its influence was felt there none the less surely. Before it retreated—first the Hardwood forest, and close on its heels the Coniferae. The Coniferae invaded the strip along the western slope of the Rockies, and also the great Northeastern Asian forest region, and remained in both, about equally strong in number of species. But in the case of the first named region what became of the Hardwood forest that pushed ahead of the Conifers? Behind it on the east were the Rockies; before it on the west the Pacific; and to the south the stern physiographic obstacles of the Mexican coast. And again, what was the character of the coniferous forest that invaded the Pacific strip? We need only point to the two Sequoias, sempervirens and gigantea, the "Big Trees" of California, the culminating triumphs of vegetative energy in Coniferae. The

Pacific strip became the refuge and stronghold during glacial times of the mightiest phalanx in the North American coniferous forest, and there they have stayed, simply because all competitors perished before their invasion. Obviously the conditions in the case of the Asian coniferous invasion were vastly different; while the comparative poverty of the coniferous element in the Appalachian forest is directly traceable to the strength of its hardwood element and the path of retreat afforded the Conifers toward the north and northwest.

A remarkable example of the development of higher types along the tensional margin-line was the glossopteris flora of the Carboniferous glacial regions,—a flora an age ahead of that of the rest of the world, and developed where the latter flora was beaten back by the glacial cold.

Many details of great interest to the systematic botanist might be outlined in this connection, but what has been suggested suffices to show how vitally important is the chapter of plant-history recorded in the woıld's tree-life. It will be found on comparison, that the record of the development and migrations of shrubby and herbaceous plants closely accords with the history of the tree-groups with which they are most closely allied. But the stability of tree characters vastly exceeds that of the characters of the lesser plant forms, and hence it is these latter that vary most in passing from one region to another. Still in this latitude we may clearly observe that the more ancient herbaceous forms are the more northerly in their range, and the newer the more southerly. The equatorial belt has become the great center of developmental activity, and out from its congested tension-margins come the vanguard of our highest floral types. The coniferous trees were all-powerful in the Mesozoic; the Hardwood trees of the amentaceous and choripetalous Dicotyls seem to have reached a climax of luxuriance in the late Tertiary; and out of the great element of sympetalous Dicotyls that predominate the herbaceous flora of the present world, there may be developed another great tree group that shall rule the forest of the far off future. The promise of this last is already to be found in the arborescent Compositæ of certain of the Pacific islands. But it is certain that forest development in the future will follow no such clearly defined courses as in the past; the wonderful complexity of the geographical botany of the present has forever sealed the possibility of another distinctive tree-group attaining such a world-wide prominence as either the Conifers or the Diclinae or the Palms. These three must stand alone as a unique monument to the struggle for existence in the primaeval Mesozoic forest. For even as the conditions of that age made possible a remarkably homogeneous plant world, even so the great tension system of the earth's present vegetation makes diversity, to an equally or more remarkable degree, the key-note of future development.

LEPIDOSIRENIDS AND BDELLOSTOMIDS.

By Theodore Gill.

I.

In the American Naturalist for November, 1893, Dr. Howard Ayers has published an article " on the genera of the Dipnoi Dipneumones" which exhibits a characteristic—" lumping "—which, may sometimes be a virtue but which, in this particular instance, has been exaggerated into a decided fault.

In 1885, Dr. Ayers created much astonishment among naturalists familiar with the history of the Lepidosirenids by not only refusing to admit the generic differentiation of *Lepidosiren* and *Protopterus,* but by contending that the representatives of the two genera were even *specifically inseparable,* and that the American habitat of the type was doubtful !

In the article just cited, Dr. Ayers has given a reluctant and grudging admission to specific rank of the two types but has unqualifiedly denied their higher rank ; grudgingly, because he concludes that " if they had to be named as new discoveries to-day, and could be studied together in so doing, most zoologists would include both animals in one genus, *even if they did not group them as varieties of one species* " (p. cit., p. 922).

Dr. Ayers' former article has been sufficiently answered by Baur, Schneider, and Parker, and his last article fails to invalidate their contentions. I shall only add that, after a comparison of the entire body as well as the skeleton of *Protopterus annectens* with the descriptions and figures of the corresponding parts of *Lepidosiren paradoxa,* I am convinced that no zoologist of mature experience would hesitate to rank *Lepidosiren* and *Protopterus* as *very distinct genera.*[1]

[1]Professor Ray Lankester, in "*Nature*" for April 12, 1894, (p. 555), has announced that he recently obtained, "by purchase from a London dealer, specimens of the Lepidosiren of the Amazon well preserved in spirit" (how many he has not told). He has illustrated peculiarities in "the limbs of *Lepidosiren paradoxa,*" and we may soon expect more details from that accomplished naturalist.

II.

In the article in the NATURALIST (p. 923), Dr. Ayers claims to " have ascertained that, taking all the *Bdellostomids* together, they form a series in which the gill variation runs between the minimum of 6 pairs and the maximum of 14 pairs, or a DIFFERENCE BETWEEN THE EXTREMES OF 8 PAIRS OF GILLS, AND YET ALL THESE INDIVIDUALS NOT ONLY BELONG TO THE SAME GENUS—THEY BELONG TO THE SAME SPECIES ! " (Big type and exclamation mark are Dr. Ayers' own).

In " Biological Lectures " delivered at Woods Holl in 1893, lately published, is reproduced (pp. 125–161) a lecture by Dr. Ayers on " *Bdellostoma dombeyi* Lac.; A study from the Hopkins Marine Laboratory." Therein Dr. Ayers has urged at length the contention just cited and has categorically stated that " the number of gills of individuals from *different localities* varies from 6 on either side to 14 on either side, with the observed intermediate stages " (p. 137).

Dr. Ayers' own record of his observation (p. 140) and summary of those of his own as well as of others (p. 156) will be an all-sufficient refutation of this claim.

" In the material which [he] was able to collect at Monterey, the following proportions of the several variations prevailed :

104	individuals	had 11	gills	on	both sides.
26	"	" 11	"	"	one side.
		and 12	"	"	the other side.
208	"	had 12	"	"	both sides.
11	"	" 12	"	"	one side.
		and 13	"	"	the other side.
8	"	had 13	"	"	both sides.

354 total number of individmals counted."

In his summary of observations on the number of gills, he gives formulas for all observations as follows :—

"*Bdellostoma*	*dombeyi*	6 gills.	
"	"	6–7	indicating the sides of the body upon which the respective numbers occurs.
"	"	7–6	
"	"	7	
"	"	10	
"	"	11	
"	"	11–12	
"	"	12–11	
"	"	12	
"	"	12–13	
"	"	13–12	
"	"	13	
"	"	14"	

It will be noticed that there is a great gap from 7 to 10 which has been straddled, but for which there is not the slightest observational basis. The logical fallacy involved is too obvious to need more than pointing out.

On one hand out of 354 specimens examined by Dr. Ayers, 208 had 12 pairs of gills and 104 had 11 pairs of gills, while 26 had 11 *or* 12 on one side. Not a single one had less than 11. No specimen with a smaller number than 10 has been recorded from the Pacific Coast.

On the other hand, of many specimens obtained in New Zealand, South Africa, etc., all had 7 or 6 and none had more.

Are not these facts sufficient to prove the distinctness of the two types?

(1) There is a gap of from 7 (maximum) to 10 (minimum) at least, between the number of gills of the two types. (2) The range of variation, considerable as it is, is limited in both directions. (3) The differences in numbers are associated with differences in geographical range. Certainly, then, the two forms are specifically distinct. Are they not generically distinct?

Dr. Ayers has truly remarked (p. 152) "It seems to have become a settled belief among the large majority of zoologists of both morphological and systematic proclivities, that the number of gills found among vertebrates never rises above eight pairs in existing forms." The deviation from this almost universal rule led me to propose the generic differentiation of "*Bdellostomids* with an increased number of branchiæ" from those "with typically 7 (sometimes 6)." Be it recalled also that the former have "the base of the tongue between the seventh or eighth pairs of gills," while the latter have "the base of the tongue between the anterior pair of gills."[2] The genera thus defined were named by me *Polistotrema* and *Heptatrema* (Proc. U. S. Nat. Mus., 1882, pp. 518, 520). These have been accepted by Jordan, Gilbert, the Eigenmanns, and others, and probably will continue to be. Dr. Ayers, however, has urged that "these accounts all refer to the varieties of what I shall call *Bdellostoma dombeyi*, adopting Müller's genus on account of the inapplicability of Lacépède's *Gastrobranchus*, and of the inappropriateness of Cuvier's *Heptatremes*, which could only be used for the seven-gilled form or variety" (p. 155).

Gastrobranchus was a generic name formed for *Myxine* alone and of course could not be perverted to a *Bdellostomid*. *Heptatrema* can be used for the group to which it was applied with perfect propriety, even though the species deviate in having often 6 branchial apertures on one or both sides. A corresponding latitude of usage is so generally recognized by modern zoologists, that a defense of such procedure is unnecessary. Even if such an extreme view prevailed, however, there is the name *Homea* of Fleming available, and this was proposed many years before *Bdellostoma*.

There are several other questions that deserve attention, but I resist the temptation to consider them now.

[2] "The relation of the tongue muscle to the gills is of interest, and here again we find great variability. Müller found it to lie entirely in front of the gills in the 6 and 7 gilled forms from the Cape of Good Hope, and this condition obtains in *Myxine* so far as known. In *Bdellostoma* with 10 or 11 gills, the base of this muscle may lie between the 6th and 8th pair of gills according to Putnam. In the 12 and 13 gilled forms, I have found it between the 5th, or at most, the 6th pairs of gill-sacks." (Ayres, p. cit., p. 139, 140). No observational basis has filled the great gap between the "front of the gills" and the interspace between the 5th pair!"

THE ORIGIN OF PELAGIC LIFE.

(FROM PROF. W. K. BROOKS.)

Chapters VII and VIII of Brooks' Memoir on Salpa embrace a discusssion of this genus in its relation to the evolution of life, and in order to clearly present its position and significance in the economy of nature the author discusses at some length the conditions under which oceanic life has been evolved. He notes first that the marine animals are almost exclusively carnivorous. They prey upon each other to an almost incredible extent, and were it not for the extraordinary fertility of pelagic organisms the rapacity of the higher forms of life would bring about their own extermination. Mr. Brooks, in commenting on the abundance of marine life, instances the great schools of mackerel, the hunters of herring, which in turn swarm like locusts. In 1879, three hundred thousand river herring were landed by a single haul of the seine in Albemarle Sound; but the herrings feed upon copepods, each one consuming myriads every day. In spite of this destruction and the ravages of armies of medusæ, siphonophores and pteropods, the fertility of the copepods is so great that they are abundant in all parts of the ocean, and not only on the surface, for banks of them are sometimes a mile thick. On one occasion the Challenger steamed for two days through a dense cloud formed of a single species. But upon what do the copepods feed? And this brings the author to the important factors in the food supply of the animals of the ocean. The basis of all the life in the modern ocean is to be sought in the microorganisms of the surface. They consist of a few simple unicellular plants, and the globigerinæ and radiolaria which feed upon them. These organisms are so abundant and so prolific that they meet all demands made upon them. They are not only the fundamental food supply, but, according to the author, the primæval supply which has determined the whole course of the evolution of marine life.

Sameness of environment and lack of competition for space have tended to make pelagic plant life retain its primitive simplicity, but existing apparently under the same conditions is an infinite variety of animal life. How can this be accounted for? In tracing the phylogeny of Salpa, Mr. Brooks finds that the structure which is so well adapted for life on the high seas has come to it by the inheritance of peculiarities originally acquired by bottom animals in adaptation to the needs of a sessile life. In this connection the author states that the majority of the present pelagic animals have not been produced at the surface of the ocean by gradual evolution from a simple pelagic ancestor, but that part of their family history has been worked out by individuals who colonized upon or near the bottom, or along the sea shore, or upon the land, and the exceptions are all simple animals of minute size. He reviews the chief groups of metazoa to demonstrate this fact and gives, as notable exceptions, some of the veiled medusæ, a few of the primitive annelids, possibly, and the copepods among the crustacea. Among the higher forms, the fishes, which at first sight would seem to have been pelagic from the beginning, so admirably are they fitted for life in the open water, are found upon examination to be only secondarily adapted to a pelagic life, like the sea-birds and the cetaceans.

Mr. Brooks bases these statements on evidence from paleontology, from embryology, and from the structure and habits of living animals.

In discussing the conditions under which the primitive pelagic fauna lived, and the comparative results of pelagic and bottom environment upon marine life, the author points out that while the animals which first settled on the bottom probably did not secure more food than did their floating allies, they obtained it with less effort and were able to devote their surplus energy to growth and multiplication. The rapid multiplication led to crowding and competition, prevented the influx of newcomers from the open water, and finally resulted in the elaboration and specialization of the types of structure already established. Evolution was rapid, for life at the bottom introduced many and new opportunities for divergent modifications.

Another result was the escape of varieties from competition with their allies by flight from the crowded bottom to the open water above. The influence of these emigrants upon strictly pelagic forms is seen in the evolution at the surface of complicated forms like the siphonophores. But, on the whole, ocean space is so great and conditions of life in open water so easy that many of the pelagic organisms retain their primitive simplicity, existing simultaneously with the large and highly organized invaders from the shore and bottom.

The colonization of the bottom formed an important era in the evolution of marine life and the author devotes a section to a consideration of the characteristics of this primitive fauna of which the following is a summary:

"1. It was entirely animal, and it at first depended directly upon the pelagic food supply.

"2. It was established around elevated areas and in water deep enough to be beyond the influence of the shore.

"3. The great groups of metazoa were rapidly established from pelagic ancestors.

"4. There was a rapid increase in the size of the bottom animals and hard parts were quickly acquired.

"5. The bottom fauna soon produced development among pelagic animals.

"6. After the establishment of the bottom fauna, elaboration and differentiation among the representatives of each primitive type soon set in and led to the extinction of the connecting forms."

In comparing these characteristics with those of the earliest known fauna as sketched by Walcott, Mr. Brooks finds that in going backward toward the lower Cambrian he finds a closer and closer agreement with the biological conception of the primitive life at the bottom. And while he does not regard the Olenellan fauna as the first bottom fauna, since it contains forms secondarily adapted to pelagic life, such as pteropods, still, "a biologist must regard it as an unmistakable approximation to the primitive fauna of the bottom, beyond which life was represented only by simple and minute pelagic organisms."

Mr. Brooks' point of view, then, is that marine life is older than terrestrial; it has shaped itself in relation to its food supply; this food supply, the microorganisms referred to above, is the only form of life which is independent and it therefore must be the oldest; from these simple types the pelagic ancestors of all the great groups of metazoa were slowly evolved until the colonization of the bottom, when a rapid advancement took place; the present highly differentiated forms which constitute the ocean fauna are the descendants of the colonizers, while the lower pelagic forms are the lineal representatives of the primitive forms, some of which are slightly modified by the influence of the emigrants from the shore and bottom.

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RECENT LITERATURE.

Gage's Microscope and Microscopical Methods.[1]—Some years ago we noticed one of the previous editions of this work, prepared for the use of the Students of Cornell University. The present, the fifth edition, is greatly enlarged and forms a most valuable guide to the microscope as an optical instrument, showing the use of each part, the means of testing and using it, correcting its faults, etc. Following this portion comes some more special directions for its use in spectroscopic and polariscopic work and in photography, together with a chapter on the mounting of slides in which every aspect of the subject, from the measuring of the thickeness of the cover glass to the labelling and storage of the slides is discussed, excepting that the staining and sectioning of the specimen is left for a second part which is announced as in preparation. This second part will deal with the use of the Microscope in Vertebrate Histology, and with the two volumes the student will not often meet with questions of technique in this line which cannot be answered by referring to this vade mecum. The work is well printed and is a credit to Comstock Publishing Company which issues it. It is well illustrated with 103 cuts while the fact that every other page is left blank, allows the student opportunity to add notes. The work will doubtless be used in many other laboratories than that for which it is especially preparared.

Shufeldt on Chapman's Birds of Trinidad.—To the Editors of THE AMERICAN NATURALIST:

DEAR SIRS:—In your issue for April, 1894, p. 332, I find a review of a paper by me on Trinidad birds in which, much to my surprise, the reviewer charges me with an attempt to place all but Passerine birds in the order Macrochires! I had intended in this paper to give the names of the sixteen orders which have representatives in the Trinidad avifauna, and under each order the families which most Ornithologists now believe to belong in it. In a vain endeavor, however, to hurry my paper through the press before sailing on a second voyage to Trinidad, the last half of the copy was unfortunately sent to the printer before the slips giving the names of orders and families had been

[1] The Microscope and Microscopical Methods by Simon Henry Gage. Ithaca, 1894, pp. viii, 165.—$1.50.

inserted. I did not see proof and the error was noticed too late for correction.

The fact that not only the names of orders but also those of *families* are wanting after "Macrochires" and "Trochilidæ," should, I think, have suggested to so practiced a reviewer that there was a *lapsus* somewhere.

It is certainly bad enough to be accused of trying to classify all but the Passeries in one order, but when it logically follows—and in this case it does—that one is also accused of attempting to crowd the same heterogeneous assemblage into the family Trochilidæ I must, in justice to myself, plead not guilty.

Very truly yours,

FRANK M. CHAPMAN.

American Museum Natural History, New York City. May 24, 1894.

Annual Report Minnesota Natural History Survey for 1892.[1]—The important papers incorporated with this report are as follows: The Geology of Kekequabic Lake with special reference to an augite-soda granite, by Mr. U. S. Grant; Report of a reconnoisance in northwestern Minnesota in 1892, J. E. Todd; and Field Observations of N. H. Winchell in 1892. A feature of general interest is a table of comparative nomenclature prepared by the State Geologist. This table gives the Minnesota Strata in order; the stratigraphy of the Wisconsin reports issued under the direction of Prof. Chamberlain; the terms used by the present Michigan survey; and the general terms used by the United States and Cananian geological surveys. These separate series are arranged so that one can see at a glance the supposed equivalents.

[1] The Geological and Natural History Survey of Minnesota. The Twenty-first Report, for the year 1892. N. H. Winchell, State Geologist. Minneapolis, 1893.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Schlosser on American Eocene Vertebrata in Switzerland.[1]—Dr. Max Schlosser has recently[1] reviewed the work of Prof. Rütimeyer of Basel on the "Eocene Fauna of Egerkingen." In this memoir Dr. Rütimeyer endeavored to show that there have been found on the Eocene bed of Egerkingen, Switzerland, certain genera of Mammalia which were previously discovered in North America, and had not been known from any part of Europe up to that time. These fossils he named as follows.

Tillodonta. *Calamodon europæus.*

Quadrumana. *Hyopsodus jurensis; Pelycodus helveticus.*

Condylarthra. *Phenacodus europæus; P. minor; Protogonia cartievii; Meniscodon pictetii.*

Dr. Schlosser makes the following critical observations on these species.

He considers the *Calamodon*[2] *europæus* to be well established.

Hyopsodus jurensis is probably an Artiodactyle allied to Dichobune. The *Pelycodus helveticus* is a lemuroid, but of a genus different from Pelycodus. *Phenacodus minor* is probably a Creodont, while the *P. europeus, Protogonia cartierii* and *Meniscodon pictetii*, Dr. Schlosser thinks belong to a single genus, which he thinks is Protogonia (Euprotogonia). He doubts whether the teeth, on which the three species are founded, belong to distinct species.

As a result Schlosser concluded that Rütimeyer in correct in determining the American genera Calamodon (Conicodon) and Protogonia, (Euprotogonia) as occurring in the Egerkingen formation. The lemuroids and creodont are of types common to both continents, while the Dichobunid is European in relationship.

Schlosser further remarks, that a boreal fauna, such as exists at present, was unknown during the Cenozoic ages. Europe was the home

[1] Zoölogischer Anseiger, 1894, no. 446, p. 157.

[2] A genus of birds has been named Calamodus, a name which is in my opinion abundantly distinct from Calamodon. As, however, there are persons who, like the American Ornithologists Union, will make this resemblance an excuse for changing the name, I suggest that they call it Conicodon, from the shape of the molars, as distinguished from those of Stylinodon.

of the Artiodactyla except Oreodontidæ and Tylopoda, of the true Carnivora, and the Monkeys (except the S. American). North America was the home of the Perissodactyla and Amblypoda, and the ancestors of the monkeys and carnivora, during that time.

The Skull of Pisodus owenii.—It is now a well-established fact that many types of Teleostomous fishes have undergone very little change since the Eocene, or even since the latter part of the Cretaceous period. Several well-defined genera seem to date back thus far, and others are represented by forms that differ in but small particulars. Moreover, a few of the most remarkable specializations in piscine skeletal anatomy chatacterizing the existing faùna are already recognizable in certain closely related Eocene types, and the progress of discovery is continually adding to the number of known examples. A most striking new case has been lately met with by the present writer among the fishes from the London Clay (Lower Eocene), and this forms the subject of the following notes.

So long ago as 1845, Sir Richard Owen described and figured the tritural dentition of an unknown fish form the London Clay of the Isle of Sheppey under the name of *Pisodus oweni* (ex. Agassiz MS.). The original specimen is preserved in the Museum of the Royal College of Surgeons, and exhibits an ovate pavement of small rounded or polygonal teeth firmly fixed in shallow sockets upon a plate of true bone. Appearances suggested to Sir Richard Owen that the fossil had been attached to another bone of the skull, most probably, as in Glossodus and Sudis, to a median bone of the hyoid system. Agassiz, who first examined the specimen, supposed it might pertain to a so-called Pycnodont Ganoid; and in Owen's Paleontology (edit. 2, 1861, p. 174) Pisodus is also doubtfully quoted as a "Ganoid" of uncertain position.

It now appears from a nearly complete skull in the British Museum that the problematical fossil in question is the parasphenoid dentition of a fish remarkably similar in cranial characters to the recent Clupeoid Albula. The fact has already been incidentally mentioned in a record of the discovery of Pisodus in the Middle Eocene of Beligium; and it only remains to justify, by a detailed description and figures, the recognition of an Albula-like fish at so remote a period as that of the Lower Eocene. Dr. Shufeldt's admirable description of the skull of the recent *Albula vulpes* fortunately suffices for requisite comparison. (Dr. Smith Woodward in Ann. Mag. Nat. Hist. Ser. 6, Vol. XI, 1893.)

Geological News, Cenozoic.—In studying the origin of Lake Cayuga, Mr. R. S. Tarr, has become a convert to the rock-basin theory of lake formation. In a paper recently published he shows that the preglacial tributaries to the Cayuga valley are rock enclosed and that their lowest points are above the present lake surface. This the author holds to be proof positive that Lake Cayuga is a rock-basin. If this be true, a similar course of reasoning would suggest that Lake Ontario is also a rock-basin, from the fact that the preglacial Cayuga River flowed north and was tributary to a river which drained Ontario, and whose channel was above the present surface of the lake. (Bull. Geol. Soc. Am., Vol. 5, 1894.)

The recognition of the extension of the Pine Barren flora of New Jersey through Staten Island, Long Island, Nantucket, Southern Rhode Island, and Massachusetts, suggests to Mr. Arthur Hollick a theory of a continued existence of land connection between New Jersey and southeastern New England, by way of Long Island, during a sufficient time after the final recession of the glacier, for the pine barren flora to have spread and become established there. This theory would seem to be supported by the position and configuration of the chain of islands to the east of Long Island Sound, and by the geological history of this region. If Mr. Hollick's views are correct Long Island, Block Island, Nantucket, Martha's Vineyard, etc., as we now know them, have not been snbmerged since the final retreat of the glacier, and their separation into islands is a comparatively modern phenomenon due to erosion, and the depression of the costal plain. (Taans. New York, Acad. Sci. Vol., XII, 1893.)

A new theory of the origin of Drumlins has been advanced by Mr. Warren Upham, viz.; they are the result of the accumulation of englacial drift. The author offers the following explanation of the manner of the accumulation. The upper current of the thickened ice above the englacial bed of drift would move faster than the drift, which in like manner would outstrip the lower current of the ice in contact with the ground. Close to the glacial boundary the upper ice must have descended over the lower part. This differential and shearing movement gathered the stratum of englacial drift into the great lenticular masses or sometimes longer ridges of the drumlins, thinly underlain by ice and over-ridden by the upper ice flowing downward to the boundary and bringing with it the formerly higher part of the drift stratum to be added to these growing drift accumulations. The courses of the glacial currents are not determined by the topography of the underlying land, but by the contour of the ice surface. (Proceeds. Boston, Soc. Nat. Hist., Vol. XXVI, 1893.)

MINERALOGY.[1]

Contributions to Swedish Mineralogy, Part I:—In this paper Sjögren[2] has given in English a very interesting series of crystallographical studies. The well known but rare axinite from Nordmarken is reexamined. In addition to the tabular crystals described by Hisinger and v. Rath's prismatic type, a third type of smaller crystals is identified having neither the tabular nor the prismatic habits and highly modified. Hedyphane which is closely related chemically to the members of the apatite group, particularly mimetite, has been supposed to possess monoclinic symmetry on the basis of Des Cloiseaux's determination in 1881. Sjögren has examined crystals from the Harstigen mine in Wermland and finds that both crystallographically and optically hedyphane is hexagonal. The crystals examined exhibited the forms oP, ∞ P, P, $\frac{1}{2}$P, 2P, P2, 2P2, and clearly belong to the apatite group. Another member of the apatite group is discovered in Sjögren's new mineral svabite, which occurs in schefferite at the Harstigen mine. Svabite is a hydrous calcium arsenate of the composition indicated by the formula $HO\,Ca_5\,As_3\,O_{12}$ in which the hydroxyl appears to be part replaced by chlorine and fluorine. The mineral is crystallographically like apatite and exhibits the forms ∞ P, P, P2, oP. The same mineral was found at Jacobsberg, enclosed in hausmannite. A very exhaustive study is made of the minerals of the humite group, all of which are found at Nordmarken. No less than 29 forms were observed on chondrodite from this locality, and these include the six new forms, $+\frac{1}{2}P, -\frac{1}{5}P, +\frac{1}{5}P, -\frac{3}{7}\bar{P}\frac{3}{2}, +\bar{P}2, -\frac{3}{11}\bar{P}\frac{3}{2}$. The humite of the locality showed 20 and the clinohumite 26 forms, all of which have been observed on Vesuvian crystals. A probable fourth member of the humite group which occurs at Nordmarken, is announced in this paper. Three new analyses of longbanite are contributed, on the basis of which the formula of the mineral is given as $m\,Sb_2O_3\,n\,Fe_2\,O_3\,p\,R^{IV}R^{II}O_3$ in which R^{IV}=Mn and Si, and R^{II}=Mn, Ca, and Mg. The symmetry of the mineral is shown to be rhombohedral, this and the chemical constitution indicating its isomorphous relation with hematite and ilmenite. Adelite is the name given to a new basic arseniate from Nordmarken, Jacobsberg and Longban, having the for-

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2]Bull. of the Geol. Inst. of Upsala, I; No. 1, (1892), pp. 1–64, pls. I–IV.

mula 2CaO, 2MgO, H_2O, As_2O_5. The symmetry of the mineral is monoclinic and its relationships, both chemical and crystallographical, are with triploidite, wagnerite and sarkinite.

Optical Methods :—Friedel[3] has devised a new method for determining the double refraction in thin sections of minerals on the stage of the ordinary petrographical microscope. The method makes use of the quarter undulation mica plate. The nicols are crossed and the slide is raised a short distance above the stage on thin blocks, so as to allow of the introduction of the mica plate between the slide and the stage. The stage is now revolved until the directions of extinction make 45° with the principal sections of the nicols. The mica plate is introduced below the slide and carefully turned without moving the stage until that portion lying outside the mineral plate is extinguished. By now revolving the polarizer, the mineral can be extinguished or given the same illumination as the mica plate. The observations are made in monochromatic light. If the positive direction of the mineral plate passes through the upper right quadrant of the field and the positive direction of the mica plate coincides with the vertical cross hair, the polarizer should be revolved to the right, the angle φ required to produce extinction, and the angle φ_1 required to produce equal illumination of mineral plate and mica plate, yielding ψ the difference in phase produced in the mineral section. The formulas are $\psi=\varphi_1$ and $\psi=2\varphi_1$. The greater part of the paper is devoted to methods of evaluating errors in the process.

Harker[4] has determined trigonometrically the values of the extinction angle in prismatic cleavage flakes of augite and hornblende, as dependent on the optical angle and the extinction angle in the plane of symmetry. His tables of values will be convenient for reference, but as he points out, the variation in the values with 2V is not great enough to determine the optical angle from measurements of the prismatic and clinopinacoidal extinction angles.

Isotypism :—Rinne[5] compares crystals of the metals with crystals of their oxides, sulphides, hydroxides and haloid compounds. He points out that in this comparison we find strikingly close relationships between bodies markedly different chemically, and these relationships do not consist simply in identity of crystal symmetry, but in

[3]Bull. Soc. Franç. Minér., XVI; 19 (1893).

[4]Min. Mag., X (No. 47), p. 239.

[5]Neues Jahrb. f. Min., etc., 1894, (I) pp. 1–55.

close approximation to a type as regards crystal shape (Krystallgestalt) and interfacial angles. Even when the symmetry of two substances is not identical, he makes comparison of the crystal shape as, e. g., between a cube and a rhombohedron with polar edge approaching 90°. The author distinguishes seven types as follows: I regular type (isometric), II magnesium type (hexagonal and pseudo-hexagonal—orthorhombic), III arsenic type (rhombohedral), IV quartz type (hexagonal tetartohedral), V α tin type (tetragonal), VI rutile type (tetragonal and pseudo-tetragonal—orthorhombic), VII β tin type (orthorhombic and pseudo-orthorhombic—monoclinic). Every group but the fourth contains metals and this type Rinne considers as derivable from the third or arsenic type. Many oxides, etc., have their crystal forms to some extent indicated in the forms of their contained metals. The term isotypism is proposed to describe these crystallographical relations between members of different divisions of the chemical mineral system. The author further states, "It must now be accepted as a fact that such substances" (elements, oxides, sulphides, haloid salts, and even silicates, which have been grouped together under his various types) "possess equivalent or very similar crystal forms, and it follows that the chemical differentiation into elements, oxides, salts, etc., finds no crystallographical expression, and therefore no independent, certain conclusion as to the chemical group to which a compound belongs can be drawn from its crystal form."

Lamellar Structure in Quartz Crystals.—In an "additional note on the lamellar structure of quartz crystals and the methods by which it is developed," Professor Judd[6] describes and figures a remarkably beautiful instance of lamellar structure in quartz, in which he sees a close analogy with the "rippled fracture" which he finds can be produced in quartz crystals by breaking them in a powerful vice along a plane perpendicular to the optic axis. The appearance of such fractures is very much like that of "engine-turned surfaces." This appearance is caused by ridges following the planes R and −R, which are often curved and die out in the manner of plagioclase lamellæ. From a study of the lamellæ in an equatorial section of quartz supposed to be one of those investigated by Brewster, Professor Judd concludes that quartz is dimorphous. What he calls "stable quartz" shows no tendency to assume a lamellar structure, whereas "unstable quartz" constantly exhibits such a tendency. The latter variety is usually amethystine. The lamellæ consist of alternating bands of

[7]Min. Mag., X, p. 123.

right and left handed quartz. When they are bent or disturbed they furnish biaxial interference figures. Many crystals are composed of both stable and unstable quartz, the relative positions of which show some relation to the symmetry of the crystal. Such crystals, or crystals composed entirely of unstable quartz, have the lamellæ induced by great mechanical stresses. The fact that the structure is only faintly induced and that very near the fracture in artificially crushed crystals, is explained by the short time during which the stress is applied, permanent structure being produced only after a long application of the stress.

PETROGRAPY.[1]

Contact Effects around Saxon Granites.—The effects of the granite and syenite of Lausitz, of the granitite of Markersbach and of the tourmaline granite of Gottleube upon the rocks through which they cut in the Elbthalgebirge in Saxony, are concisely described by Beck.[2] The members of the phyllite formation and the beds of Cambrian, Silurian and Devonian age, whatever may have been their nature, have all undergone contact metamorphisen near ther junction with the eruptives. During the process of alteration there seems to have been little addition of material to the metamorphosed rocks, as all the contact products when originating from the same member of the bedded series are the same, irrespective of the nature of the metamorphising eruptive. The great variety in the contact products of the region is due solely to differences in the character of the originals of the altered rocks. The phyllites have been changed to 'Fruchtshiefer' and into andalusite mica schists, chlorite gneisses into biotite gneiss, and feldspathic quartzites into hornfels. The Silurian slates near the contacts have become hornstones and knotty schists, carbonaceous quartz schists have changed into graphitic quartzites, graywackes and marbles have been made crystalline, and the latter rock has in many cases been changed into a calc-silicate aggregate, which has been impregnated with ore masses, presumably originally in the granitite with which the limestones were in contact. Diabases and diabase tuffs in proximity to the intrusive rocks have been amphibolized. The Devonian rocks have suffered the same alterations as the corresponding Silurian ones, and in addition there has been formed a gneiss-like rock whose predecessor among the clastics is unknown. A large number of contact minerals are discussed at length by the author, chief among them being quartz, plagioclase, cardierite and graphite. The article is full of instructive suggestions though nothing of striking novelty is met with in it.

The Schists of the Malvern Hills.—Callaway[3] has published a final summary of the conclusions based on seven years work in the Malvern Hills. He reiterates his belief that the schists of the region

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2]Min. u. Petrog. Mitth. XIII, p. 290.
[3]Quart. Jour. Geol. Soc., XLIX, p. 398.

are squeezed eruptives, and discusses the physical, mineralogical and chemical changes that have effected the alteration of the granites and diorites into gneisses and schists of various kinds. His conclusion that a sericite schist may be derived from diorite and that biotite is often an alteration product of chlorite are both of great interest. In the change of a massive into a schistise rock, the author states that the former "passes through the intermediate state of a laminated grit, which thus simulates a true sediment, the subsequent stages of alteration and cementation resembling the process of metamorphism in some bedded rocks." In the production of the foliation there is decomposition of the original components of the massive rock and a reconstruction of new minerals largely from these decomposition products. In the Malvern Hill rocks orthoclase has been replaced by quartz and muscovite, plagioclase by quartz and muscovite, chlorite by biotite and white mica, and biotite by a white mica. A number of analyses appear in the paper to illustrate the chemical changes that have accompanied the physical ones through which the respective rocks have passed.

A Soda-Rhyolite from the Berkeley Hills, Cal.—In the Contra Costa Hills near Berkeley, California, are occurrences of a volcanic flow that has been investigated by Palache,[4] who recognizes three facies of the rock. In the first, the porphyritic phase, phenocrysts of quartz and feldspar are abundantly disseminated through a micro-granular aggregate of the same minerals. The second phase is characterized by the possession of numerous small spherulites in a glassy matrix, in which are a few small grains of magnetite and some feathery aggregates of chalcedony. The third phase is a glass containing tiny microlites of feldspar and grains of magnetite. Analyses of the different types indicate that the material of each type has the composition of a soda-rhyolite. The spherulitic variety which is intermediate between the other two, in its acidity is composed as follows:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	Total	Density
75.46	13.18	.91	.95	.10	1.09	6.88	.93	= 99.50	2.42

Diabases from Rio Janeiro, Brazil.—Sections from a series of twelve diabase dykes from Rio Janeiro, Brazil, have been investigated by Hovey,[5] with some interesting results. The chemical composition

[4]Bull. Dept. Geol. Univ. Cal., Vol. 1, p. 61.

[5]Min. u. Petrog, Mitth. XIII, p. 211.

of all the dykes is practically the same. Their mineral composition and structure, however, vary. In the largest dykes the number of constituents discovered is much greater than in the smaller ones. They embrace the usual diabase components with the addition of a light colored sahlitic pyroxene differing from the sahlite of Sala in the value of its optical angle. In the Brazil mineral $E_a=32° 39'$, while in the Sala mineral it is 112° 30′. It is the oldest constituent of the rock after magnetite, and, consequently it is that which approaches most nearly to being idiomorphic. The structure of the large dykes is gabbroitic and ophitic, whereas that of the small ones is porphyritic and hyalopilitic, with the pyroxene figuring as the phenocrysts. Quartz is not uncommon in the coarser rocks and granophyric intergrowths of quartz and feldspar are frequently met with.

The New Island off Pantelleria—A Correction.—In these notes for December[6] last, the statement was made concerning the material of a recent eruption near Pantelleria, that it consisted of loose blocks and of lava. Mr. G. W. Butler of Chertsey, England, corrects this statement in a recent letter to the writer and declares that the new island formed during the eruption was composed entirely of loose scoriaceous bombs, which disappeared a short time after the eruption ceased.[7]

Petrographical Provinces.—Iddings[8] gives a brief and, consequently, a tantalizing account of the old volcano of Crandall Basin in the Absaranka Range of Mountains in the Yellowstone National Park, that has been eroded in a manner to give a good section of the cone with the dykes and flows radiating from it. The different rock types mentioned in the paper are simply alluded to, a full account of them being promised later. The author's conclusion from his study is to the effect that we have here proof that the texture of rocks and their mineral composition is more directly dependent upon the rapidity with which the rocks cooled, than upon the pressure to which they were subjected during their solidification. The differentiation of rock magmas is also well shown in the case of the volcano studied by the production of many individual rock types.

Upon comparing thirty-nine of the best analyses of rocks occurring in the eruptive areas around the Bay of Naples, Lang[9] concludes that

[6]AMERICAN NATURALIST, Dec., 1893, p. 1088.

[7]Cf. also G. W. Butler; *Nature*, April 21, 1892.

[8]Jour. Geol., Vol. 1, p. 606.

[9]Zeits. d. deutsch. geol. Ges. XLV, p. 177.

there are here three independent volcanic centers, represented respectively by Ischia, Vesuvius and Mt. Nuovo. That they are on different volcanic fissures is indicated by the differences in the character of the lavas extruded from them, especially in their sodium and calcium contents. At each center each magma became differentiated, and this differentiation explains the variety of the rock types discovered in each.

'A study in the consanguinity of eruptive rocks' is the title of an article by Derby[10] in which is shown the fact that the occurrence of the eleolite syenites, phonolites, monchiquites and other related rocks in Brazil, point to the correctness of the notions of differentiation and consanguinity as explanatory of the existence of different phases of eruptive rocks within the same volcanic sphere. The author also shows that, while not having formulated the theory, its principle has been the guide in his work on the Brazilian rocks.

Miscellaneous.—Upon examining spherulites of lithium phosphate between crossed nicols, McMahon[11] finds that some of the groupings present apparently miaxial crosses which remain fixed in position during a complete revolution, while in others the cross breaks up into two hyperbolic branches resembling those of biaxial optical figures. The phenomenon, the author regards as due to molecular strains that affected the spherulites at the time of their crystallization.

[10]Jour. Geol., Vol. 1, p. 579.

[11]Mineralogical Magazine, X, p. 229.

BOTANY.[1]

Thaxter's Studies of the Laboulbeniaceæ.—Mr. Thaxter has recently issued the fifth of his preliminary papers upon the *Laboulbeniaceæ* preparatory to the monograph of that group upon which he is engaged. In this paper he describes four new genera and fourteen new species, and gives a synopsis of the described species of the group. As it is indicated that the paper in question is to be the last of his preliminary papers, a few words as to his work upon the group and the effect which it seems likely to have may be timely.

Although the first representatives of the family were noticed as early as 1853, and received their first systematic treatment in 1869, it is only within a short time that the group has been thoroughly studied and any great number of forms discovered. In fact the great majority of the forms have been found in this country by Mr. Thaxter. In the first of his preliminary papers, in 1890, Mr. Thaxter states the total number of described species at fifteen. In the present paper he enumerates in the course of his synopsis twenty-three genera and one hundred and twenty-two species. The difference is mostly due to his researches.

The *Laboulbeniaceæ* are parasites on the outer surfaces of insects, principally of insects which live in or about the water. They grow either singly or in a thick fur, and are very minute, the largest not exceeding 1 mm., and most species being about 0.5 mm. in length. They have no mycelium and consist solely of a short stalk and a reproductive apparatus.

Reproduction in these fungi is of one sort only. Karsten was the first to describe it and he compared it to the sexual reproduction in the *Florideæ.* Peyritsch afterward made more exact and extensive observations and came to the conclusion that the supposed abscission of spermatia did not take place and that the sexual nature of the process was doubtful. Since these observations little or nothing has been published on the subject and for that reason the following statement made in the present article is of great interest:

"The writer's observations, based upon an examination of several thousand specimens illustrating more than one hundred species and

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

more than twenty genera, appear to warrant the following conclusions."

"The *Laboulbeniaceæ*, while showing no signs of any non-sexual mode of reproduction are characterized by a well marked sexual type closely resembling that of the simpler *Florideæ*."

He goes on to give a summary of the process, which cannot well be abbreviated, and which is too long to be repeated in this place. Suffice it to say that he has found that "the trichogyne varies from a simple vescicular receptive prominence, or short filament, to a copiously branched and highly developed organ," that, however highly it may be developed, it always disappears immediately after fertilization; that the antherozoids are non-motile spherical or rod like masses of naked protoplasm, which originate in two genera exogenously from special branches and in other genera are produced endogenously in antheridia; that the antheridia are either single specialized cells or highly developed multicellular bodies, from which in either case the antherozoids are discharged through a terminal pore. It appears also that while the sexes are commonly present in the same individual, in some species they are completely separated on specialized individuals.

Although the observations, on which the foregoing conclusions are based, are not given, we may take it to be settled that the doubts as to the nature of the reproduction in these fungi raised by the observations of Peyritsch are set at rest. If so, several interesting questions arise.

There seems to be no doubt, as Mr. Thaxter remarked in a prior paper, that these fungi are real *Ascomycetes*. Indeed their title to a place in that group seems much better than that of some others which are included with little hesitation. If they are *Ascomycetes*, the ghost of the much vexed question of sexual reproduction in that group, which it was supposed had been effectually laid by Brefeld, must soon begin anew its visitations. And in any case, since the relationship of the *Laboulbeniaceæ* to the *Ascomycetes* as a whole must be close, even though they have no apparent relationship to any particular group of them, the whole scheme of the relationship of the *Ascomycetes* framed by Brefeld and his followers is placed on very shaky ground by the conclusions which Mr. Thaxter has announced.

After it had been shown that there was no sexual process in the *Ascomycetes*, the question remained, to what fruiting stage of the simpler fungi does the ascus stage of the *Ascomycetes* correspond. Brefeld has answered this by comparing it with the sporangium fructification of the *Mucoraceæ*. The ordinary *Ascomycetes*, called *Carpoasci*, he derives through *Thelobolus* from the carposporangic *Zygomycetes*, as *Mortierella*.

But the fact that in the *Laboulbeniaceæ* an ascus fructification is produced as the result of a sexual process throws grave doubt upon this theory, if it does not wholly overthrow it. It seems clear that the process of reproduction in these fungi, as outlined by Mr. Thaxter, indicates that the comparison of the ascus to the sporangium of the *Mucoraceæ* is wholly erroneous and that DeBary was right in considering it homologous to the sexual fructification of the *Phycomycetes*, whether or not he was wrong in believing it to be in many cases the result of a sexual process. It is perhaps not without significance that works like Von Tavel's Morphologie do not notice the *Laboulbeniaceæ* at all.

Another and still more interesting question will be presented when some one in the light of the development of the *Laboulbeniaceæ* ventures to reopen the question of the formation of the spore-fruit in the *Ascomycetes* and to question the conclusions of Brefeld. That the evidence must be reexamined seems to be clear if the conclusions announced by Mr. Thaxter are sustained by his observations. We have come to regard all accounts of sexual processes in fungi as doubtful since the writings of Brefeld have produced a school of sceptics on such points. If in a group which must be admitted to be immediately related to the *Ascomycetes*, if not a veritable member of them, which it evidently is, antheridia, antherozoids, and trichogynes—terms which the works on the morphology of the fungi have agreed to discard for the higher fungi—actually occur, we cannot rest content with any explanation of the formation of the sporocarp in the *Ascomycetes* which leaves any phenomenon apparently connected with those found in the *Laboulbeniaceæ* unaccounted for.

Mr. Thaxter's brief sketch suggests many coincidences which serve to convince one that the ghost of the DeBaryan theory as to the *Ascomycetes* will not down and that we may expect it to visit our slumbers nightly until we find some better means of reconciling the *Laboulbeniaceæ* with current theories as to the *Ascomycetes* than at present seems possible.

Mr. Thaxter's forthcoming monograph will be awaited eagerly by all who are in any degree interested in the morphology and biology of the fungi. It goes without saying that his previous work is a guaranty that our expectations will be amply realized.

Roscoe Pound.

ZOOLOGY.

The Antennal Sense Organs of Insects.[1]—During his studies carried on in Leuckart's laboratory on the peculiar sense organ in the the base of the antenna of certain Diptera *(Mochlonyx culiciformis, Corethra plumicornis)*, Mr. C. M. Child found that the organ occurs generally in Diptera, and, if not generally, at least very often in the other orders of Insects.

In the wasp (*Vespa vulgaris*) the organ occurs in the second joint of antenna. Near the end of the first joint the main nerve of the antenna gives off branches on all sides. These run toward the periphery of the second joint, connecting with ganglion cells, which in turn connect with small rod-like bodies that end in the articular membrane between the second and third joints. These rods are gathered into groups each of which ends in a pore in the membrane. On the outside of the antenna no sense hairs are found corresponding to these pores, which seem to be closed on the outside. Between the rods nuclear elements were found, but whether they were of connective tissue or of nerve elements was not determined. An organ similarly placed and of similar structure is to be found in the genera: *Melolontha* (*Coleoptera*), *Epinephele* (*Lepidoptera*), *Bombus* (Hymenoptera), *Pachyrhina, Tabanus, Syrphus, Helophilus, Musca, Sarcophaga* (Diptera) *Sialis, Panorpa,* and *Phryganea* (Neuroptera), *Libellula* (Pseudoneuroptera.)

Of the Hemiptera only the Homoptera were investigated. Here the rods and ganglion cells are fewer in number. *Periplaneta, Locusta* and *Stenobothrus* among Orthopteran genera have a structure in the second antennal joint with ganglion cells and long fibrous rods. Thysanura were not studied.

In certain Diptera (Culicidæ and Chironomidæ) the organ is somewhat different. At the base of the antenna of both sexes there is a nearly spherical joint. This is larger in the male than in the female. In the latter the nervous structure within this joint is much more readily comparable to the organ described for the wasp than that in the male. But even in the male the structure may be reduced to the general type. In the female the rods instead of ending at the periphery of the second joint are directed toward the middle of the long feeler. The large antennal nerve runs chiefly to the ganglion cells, giving off two small branches that run on into the other joints of the antenna. There is no

[1] Zool. Anz. XVII, p. 35, 1894.

sharp line to be drawn between the ganglion cells of the organ and the brain. The rods are delicate and covered with small nuclei very well supplied with chromatin.

To what has already been made known by Weismann and Hurst on the general development of the antenna in these insects, Mr. Child adds that the entire sense organ is formed from a fold at the base of the invaginated hypodermal cavity, and that the differentiation of the rods and ganglion cells takes place very early.

The organ he considers to be auditory in function, agreeing with Johnston, Mayer and Hurst.[2] Supporting this view is the fact that the rods are so placed as to be affected by any slight motion imparted to the distal part of the antenna, either by sound waves or otherwise. It has been repeatedly shown by others that certain insects seem to hear by means of their antennæ. To offset the fact that the so-called tympanum of certain Orthoptera is considered to be auditory he recalls the experiments by Graber, who found that insects in which the tympanum had been destroyed still reacted to sound waves which affected the antennæ or in some cases the legs. The organ is of further interest in that there is shown in it no marked difference between hearing and touch.—F. C. KENYON.

The Luminous Organs of Histioteuthis rueppellii Verany.—Dr. Joubin has recently been making a study of the luminous organs of a rare cephalopod, *Histioteuthis rueppellii*, found near Nice. The animal belongs to the abyssal fauna and the specimen in question is over a meter in length. The author describes the outward appearance of its phosphorescent organ, and its internal organization, comprising a reflector, which the author calls a mirror and an apparatus for producing light. Mr. Jourbin offers the following theory of the use of the luminous organ to the animal.

" Ordinarly the light-producing apparatus does not function. It is like a machine at rest. But if a living creature suitable for food wanders into the vicinity of the cephalopod, this prey being of a higher temperature than the water in which it floats emits caloric radiations. These heat rays impinge on the reflecting mirror and are then concen-

[2] Johnston.—Auditory Apparatus of the Culex Mosquito. Journ. Micr. Sci. III, old series.

Mayer.—Reseaiches in acoustics. Am. Journ. Sc. Series III, vol. 8.

Hurst.—The Pupal Stage of *Culex*, Inaug.-Diss. Leipzig, 1890.—On the Life History and Development of a gnat. Trans. Manchester, Micro. Soc., 1890. The Post-embryonic Development of Culex. Proc. Liverpool Biol. Soc. IV.

trated in the light-producing apparatus, causing there a sensation, and the organ functions by reflex action. The surrounding medium is then illuminated by rays perceptible by the eye of the animal. In a word, these organs are the organs of a caloric sense. Heat sensations are the only kind that can be felt in those abysses when the darkness is relieved by occasional gleams of phosphorescent light. I add, finally, that I have found in another cephalopod an extremely curious organ constructed in such a manner that it does not perceive light rays, but can only receive heat rays, which confirms the hypothesis just advanced," (Bull. Soc. Sci. et Med. de l'Ouest France, t. II, no. 1893.)

Verrill's Organ.—In the funnel of certain Cephalopods, several authors have noticed a peculiar cushion-like organ, situated a little behind the valve, and this has, for very insufficient reasons, been called Verrill's Organ by Hoyle and others. Its function and homology have been the subject of some discussion. Ferussac and D'Orbigny confused it with a transverse muscle; H. Müller, in 1852, thought it was a stinging organ; Verrill, in 1882, considered it "the true homologue of the foot of gasteropods;" Laurie, in 1888, from rather insufficient material, showed its glandular nature, and believed that it secreted mucus, but his observations were criticised by Brock; Hoyle, in 1889, believed that it served to close the funnel. That it is really a mucous gland is now proved by the careful observations of G. Jatta (Boll. Soc. Nat. in Napoli, vol. VII, p. 45, 1893), who has observed it in 32 species belonging to 21 genera, thus bringing the number of genera in which it has been found from 10 to 27. He describes and figures six main modifications of its arrangement, and gives excellent drawings to show its microscopic structure in different stages of its development. He concludes that this funnel organ is a mucous gland homologous with the pedal glands of other mollusca. If this be so, the organ must be somewhat archaic, and one would expect to find it in *Nautilus*, where, to the best of our knowledge it has never been described. (Nat. Sci., Feb., 1894.)

Preliminary Descriptions of Some New South American Characinidæ.—1. *Tetragonopterus heterorhabdus.* This species is related to *T. schmardæ* Steindachner. It is readily distinguished from *T. schmardæ* by the conspicuous dark lateral band which has on the anterior end an oval expansion resembling the humeral spot present in in many species of *Tetragonopterus.*

D. 10 ; A. 20–23 ; head $3\frac{1}{2}$; depth $3\frac{1}{2}$, eye in the head $2\frac{1}{2}$ and once in the inter-orbital ; scales 32–34, the lateral line incomplete, only 6 scales perforated.

Maxillary toothless, extending nearly to the centre of the pupil of the eye. The dark-brown lateral band, deepest colored anteriorly, edged above with a conspicuous silvery band. No caudal spot. Dorsal about midway between the tip of the snout and base of the caudal, and over the space between the anal and ventral. Anal with first six rays elongate. Many specimens from Brazil. Length 10–29 mm.

2. *Tetragonopterus paucidens.* Related to *T. diaphanus* Cope from which it differs in having 1 to 3 maxillary teeth ; in proportions and in lateral markings.

Head $3\frac{1}{2}$; depth $2\frac{3}{4}$, in the length. Snout $3\frac{1}{2}$, diameter of the eye 3 in the head. The maxillary extends to the anterior border of the pupil. A silvery lateral band and a diffuse caudal spot present. No humeral spot.

D. 11 ; A. 19 ; scales 5–31–3 ; lateral line complete. Length 45 mm. One specimen from Itaituba, 45 mm. long.

3. *Tetragonopterus santaremensis.* This species has much the appearance of *T. bellottii* Steindachner. The scales of the lateral line are perforated to the base of the caudal while in *T. bellottii* only 5 to 7 scales are perforated. The caudal spot is somewhat more rhomboidal and extends to the end of some of the rays, otherwise the lateral band and humeral spot are about as in *T. bellottii.*

Head $3\frac{1}{2}$; depth $3\frac{1}{4}$ in the body. D. 10 ; A. 20–22 ; scales 5–30–3. Anterior dorsal and anal rays elongate. Snout short, 4 in the head. Maxillary toothless, extends to the eye. Diameter of the eye somewhat more than the width of the inter-orbital and $2\frac{1}{2}$ in the head.

Ten specimens from Santarem, 8–24 mm. long.

4. *Tetragonopterus astictus.* Related to *T. humilis* Günther. It differs from that species in having no caudal or humeral spot, no red margins on the anal and ventral fins and fewer rows of scales.

Head $3\frac{1}{2}$, depth $3\frac{1}{2}$, in the length. Eye $2\frac{1}{2}$ in the head and once in the inter-orbital space. A silvery lateral band present, most distinct posteriorly.

Lateral line complete, scales 5–35–$3\frac{1}{2}$. D. 10 ; A. 30. Maxillary toothless, extending a little past the anterior margin of the orbit.

One specimen 53 mm. long from Brazil.

5. *Aphyocarax maxillaris.* Maxillary with minute teeth along its entire margin. Intermaxillary with about ten teeth, the inner four three-pointed. Mandible with a few conical teeth in front.

Depth 3–3⅓; head 3½. D. 11; A. 22–23 scales; 30, tubes 6. Snout very short, the maxillary extending beyond the anterior margin of the eye.

A small circular humeral spot present, sometimes reduced to two or three color cells. A large black spot on the upper half of the first dorsal rays, the tips of these rays white. A small black spot near the tip of the first fur and rays.

A. agassizi Steind. differs from *A. maxillaris* mainly in its larger number of anal rays. Brazil, 10 specimens, 10–11 mm. long.

6. *Aphyocarax heteresthes.* Maxillary teeth six, conical. Intermaxillary with eight conical teeth and two with lateral cusps on each side. This species is related to *A. agassizii* Steindachner and *A. eques* Steindachner. From the former it differs in having only the upper part of the maxillary dentiferous and apparently in having the anal rays graduated. From the latter it differs chiefly in having no humeral spot.

Depth 3; head 3⅓. D. 11; A. 27–30; scales about 31. Snout very short, maxillary long, extending considerably beyond the anterior margin of the eye. Eye twice the length of the snout, $\frac{2}{7}$ the length of the head. Origin of the dorsal midway betweeen the tip of the snout and the base of the caudal. Upper half of the first five developed rays of the dorsal black.

Brazil, 6 specimens, 14–17 mm. long.

7. *Mylesinus macropterus.* Body deep, $1\frac{4}{7}$ in the length. Head 3½. Abdominal serrations 11 behind the ventrals, the posterior four in pairs, 22 to 25 smaller ones before the ventrals.

D. I, 16; A. 36; V. 7. Scales small, about 83 in the lateral line which is deeply curved below the origin of the dorsal. Height of dorsal fin $2\frac{2}{3}$ times its length, the second and third rays greatly elongate, the fourth ray about half as long. Anal without lobes.

Snout little more than half as long as the diameter of the eye, the inter-orbital space a little more than the diameter of the eye. Lower jaw greatly projecting. Teeth in the mandibles in one series, notched and wide apart.

Brazil, 1 specimen 9 cm. long.

ALBERT B. ULREY, Bloomington, Ind.

On the Species of Himantodes D. & B.—This genus of snakes is represented by numerous individuals in tropical America, and sufficient material is now at hand to render it possible to determine the number of species to which they belong. An examination shows that the typical species *H. cenchoa* L., does not occur in Central America and Mexico, the individuals which have been hitherto referred to it, representing another species, which I call *H. semifasciatus*. Of the seven species, five belong to this region, and two to continental South America.

I. A small additional superior preocular plate.

Scales in 17 rows; superior labials 4 and 5 in orbit; one scale in first temporal row; vertebral row enlarged; dorsal spots extending to gastrosteges throughout; *H. cenchoa*[3] L.

II. One large preocular plate only.

α. Scales in 15 rows.

One scale in first temporal row; superior labials 4, 5, and 6 bounding orbit; vertebral row enlarged; dorsal spots terminating in an angle near gastrosteges; no lateral spots; *H. lentiferus* Cope.

αα. Scales in 17 rows.

β. One scale in first temporal row.

[Two labials in orbit; vertebral scales enlarged; on posterior two-thirds the length the dorsal spots are small and lateral spots are present; exceptionally, *H. semifasciatus* Cope.]

Two labials in orbit; vertebral scales similar to the others, spots as in *H. semifasciatus*; *H. gemmistratus* Cope.

ββ. Two scales in first temporal row.

γ. Dorsal spots continued to gastrosteges throughout.

Vertebral row enlarged; superior labials 4 and 5 in orbit; *H. leucomelas* Cope.

Vertebral row like other scales; superior labials 4, 5, and 6 in orbit; *H. tenuissimus* Cope.

γγ. Dorsal spots reduced posteriorly; lateral spots.

Vertebral row enlarged; *H. semifasciatus* Cope.

[Vertebral row like others; exceptionally, *H. gemmistratus* Cope.]

III. A small inferior preocular plate.

β. Two scales in first temporal row.

Scales in 17 rows; vertebrals large, wider than long; labials 4 and 5 in orbit; dorsal spots continued to gastrosteges throughout; *H. anisolepis* Cope.

Himantodes lentiferus sp. nov. Besides the characters already mentioned, this species exhibits the following: Labials eight above, ten below. Seventh superior labial as high as long; temporals 1–2–3. Postgenials in contact anteriorly, separated by two scales posteriorly.

[3] Specimens from Brazil and E. Ecuador from Prof. Orton.

Superior postocular three times as large as inferior. Vertebral scuta wider than long. While the dorsal spots are acute angled below generally, they are not so on the tail and anterior region; on the latter many of them are separated by a much smaller vertebral spot. Top of head brown, brown spotted; lips and throat unspotted; other inferior regions black speckled. Total length 622 mm.; tail 189 mm. Pebas, Ecuador, J. Hauxwell; E. Equador, J. Orton.

The characters of this species are well marked, as compared with those of the *H. cenchoa.* Of the latter I have four from Peru (Orton) and one from Ecuador (Hauxwell.)

Himantodes semifasciatus sp. nov. The width of the vertebral series of scales varies in the numerous specimens I have assigned to the *H. semifasciatus;* in some the width is nearly equal to the length, while in others it is considerably less. The apices of the vertebral scales are, however, always truncate, and never acuminate like the other scales, as is seen in the *H. gemmistratus.* There are usually two scales in the first temporal row in this species, while there is invariably only one in the *H. gemmistratus,* but in three of the nine Costa Rican specimens there is but one scale. The largest specimens belong to the *H. semifasciatus.* One of these (No. 101) measures; total length 1125 mm.; tail 380 mm.

Ten specimens from Costa Rica; Paso Azul, Santa Clara, Carrillo, Alajuela, Monte Aguacate, and San José; from the Museo Nacional, through Geo. K. Cherrie. Two specimens in Mus. Academy, Philada. from Nicaragua.

Himantodes anisolepis sp. nov. Besides the characters already mentioned, the following may be noted. The small inferior preocular is cut from the fourth superior labial; the labials number eight above and ten below. The lower post-ocular is one-third the size of the superior. Temporals 2–2–3. The postgenials are entirely separated by scales. Thirty-nine brown spots from the head to the vent, which extend nearly to the gastrosteges, with truncate or rounded inferior border, on a very pale ground. Belly unspotted. Total length 420 mm. of tail, 127 mm. Monte Aguacate, Costa Rica, G. Witting.

This slender species resembles in coloration the *H. tenuissimus* and *H. leucomelas.* It differs sufficiently in scale characters from both.—E. D. Cope.

Zoological News.—M. de Guerne recently reported to the *Société Acclimatation de France* the capture in the open sea of a female eel bearing mature eggs. (Rev. Sci. March, 1894.)

Prof. Carl Eigenmann is in receipt of a Ling (*Lota lota maculosa*) from the Columbia River which does not show any specific differences from those of Lake Michigan. This fish is found in all three of the large water basins of the Atlantic slope—the Saskatchewan, St. Lawrence and Mississippi, and its distribution is now extended to the Pacific Slope. (Science Vol. XXIII, 1894.)

Distomum leptodon, a new Trematode from the intestine of *Aplodinotus grunniens* (River Drum) has lately been described by W. G. MacCallum in a paper before the Natural Science Association of Toronto University.

ENTOMOLOGY.[1]

The Pear Leaf Blister.—Mr. M. V. Slingerland has recently rendered an important service to economic entomology by showing that the injuries of *Phytoptus pyri*, the mite which causes the pear leaf blister can be controlled by spraying the trees in winter with kerosene emulsion. In a recent bulletin[2] he presents the most satisfactory account of this pest that has yet been published, recording the experiments which have led to the discovery of the remedy. The disease is said to appear on the leaves early in spring "in the form of red blister-like spots an eigth of an inch or more in diameter. During this red stage of the disease, the spots are more conspicuous on the upper surface of the leaves. About June 1, the spots gradually change to a green color hardly distinguishable from the unaffected portions of the leaf; this change takes place on the lower side of the leaf first, and the spots may thus be red above and green below. In this green stage, which seems to have been overlooked, the badly diseased leaves present a slightly thicker corky appearance; otherwise the disease is not readily apparent especially where not severe. This green stage lasts about a week or ten days; and about June 15, the spots may be found changing to a dark brown color beginning on the lower side of the leaf. The tissue of the diseased parts or spots then presents a dead, dry, brown or black, corky appearance. The spots are also more conspicuous on the lower side and remain unchanged until the leaves fall in the autumn. They occur either singly scattered over the surface of the leaves or often coalesce forming large blotches which sometimes involve a large portion of the leaf."

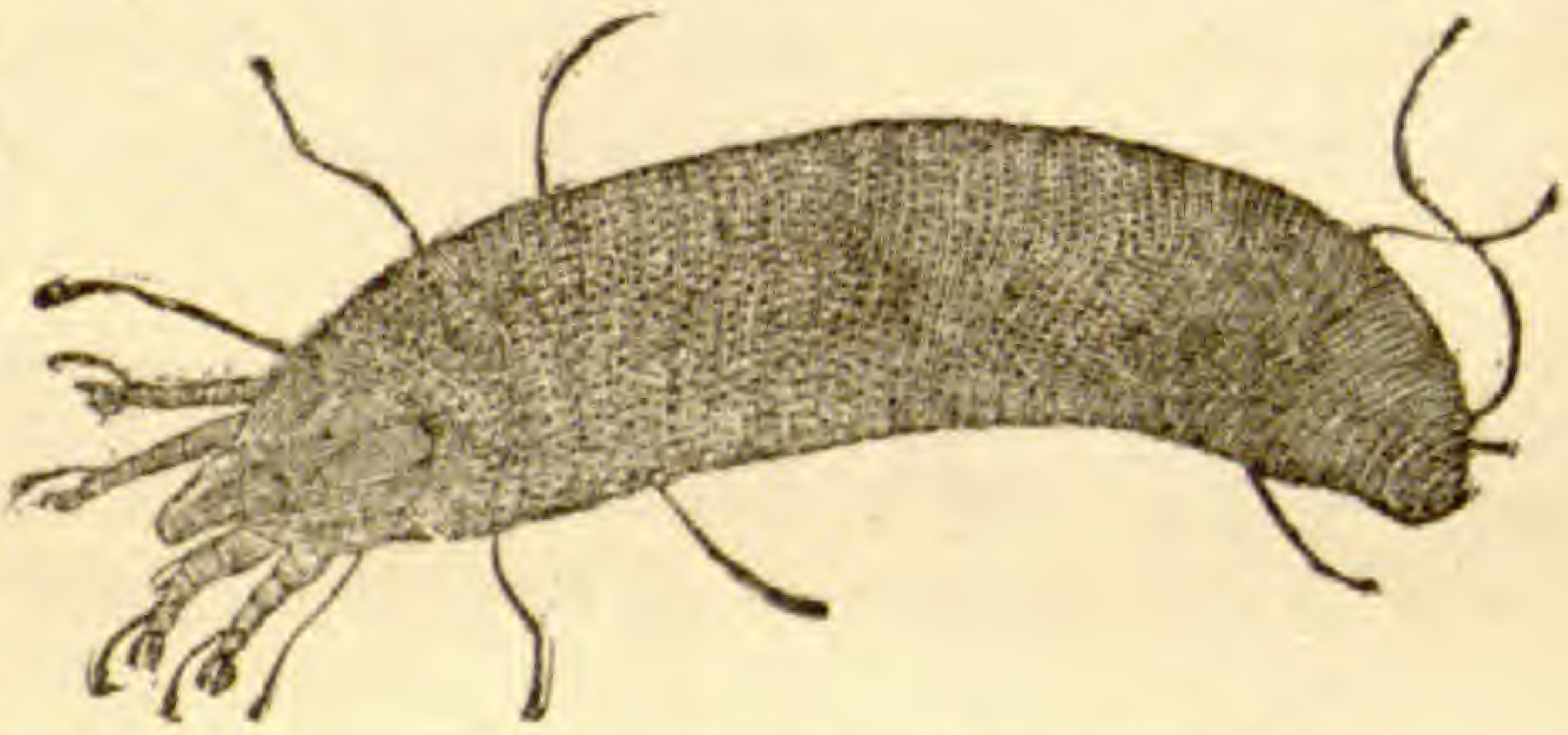


Fig. 1.—*Phytoptus pyri*. Magnified.

In describing the life history of the Phytoptus mite Mr. Slingerland says: "The exceedingly minute oval grayish eggs are laid by the females in the spring within the galls that they have formed, and here

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Cornell University Agr. Exp. Station Bull. 61, pp. 317–328

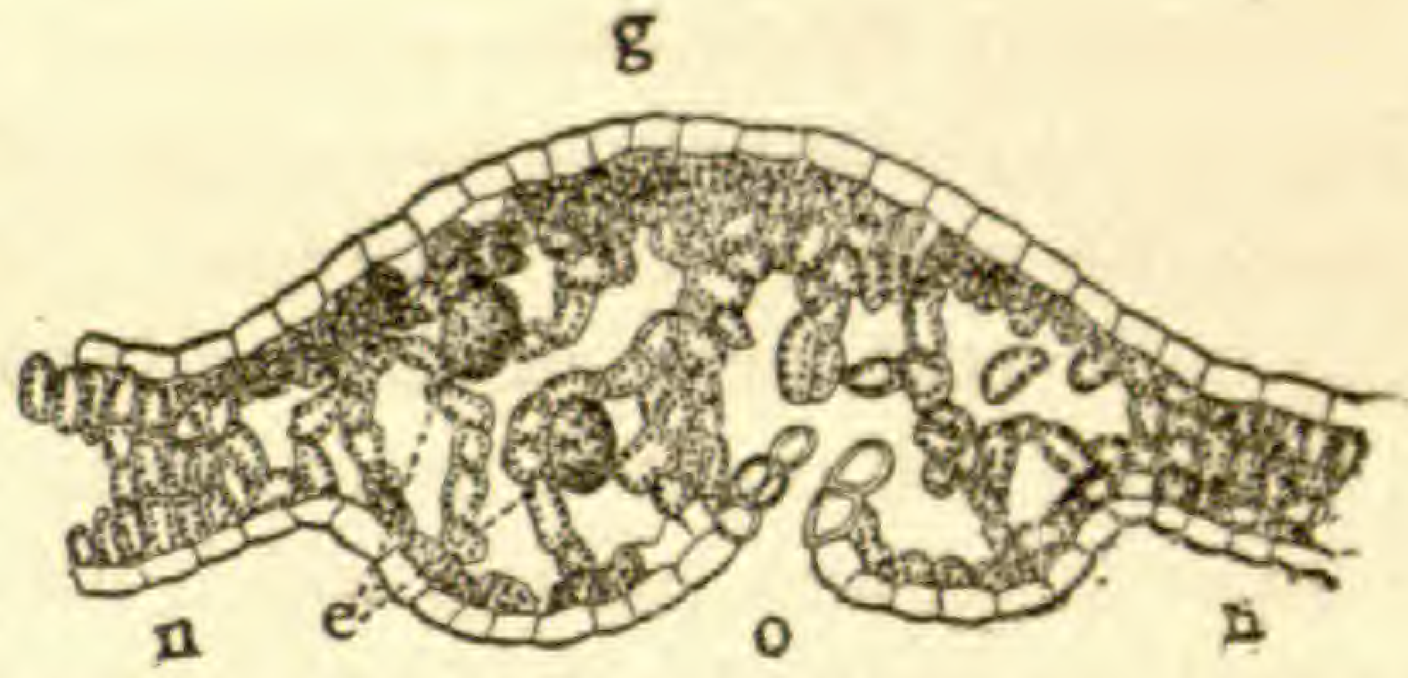


Fig. 2.—Section of leaf showing gall in red stage, *n*, *n*, normal leaf; *o*, opening of gall; *e*, eggs. (After Sorauer).

the young are hatched. How long they remain within the gall of their parent has not been ascertained. But sooner or later they escape through the opening in it, and seeking a healthy part of a leaf or more often crawling to the tenderer leaves of the new growth, they work their way into the tissue and new galls are thus started. In this manner the galls on a tree are often rapidly multiplied during the summer. The mites live within the galls, feeding upon the plant cells, until the drying of the leaves in the autumn. They then leave the galls through the openings and migrate to the winter buds at or near the ends of the twigs. Here they work their way beneath the two or three outer scales of the buds where they remain during the winter. Fifteen or twenty may often be found under a single bud scale. In this position they are ready for business in the spring as soon as growth begins; and they doubtless do get to work early for their red galls are already conspicuous before the leaves get unrolled.

"The mites instinctively migrate from the leaves as soon as the latter become dry. Whenever branches were brought into the insectary, as soon as the leaves began to dry, the mites left them and gathered in great numbers in the buds. It is impossible to accurately estimate the number of mites that may live in the galls on a single leaf. Sections of galls made while in their red stage would seldom cut through more than two or three mites; but sections of the brown galls often showed four or five times as many. Thus on a badly infested leaf there is without doubt at least a thousand of the mites."

Fig. 3.—Section of the leaf showing structure of gall in autumn; *g*, gall; *n*, normal leaf; *o*, opening of gall.

The upper figure on the accompanying plate shows a cluster of infected leaves representing the brown stage of the disease as seen from below on three leaves and from above on one leaf; and the lower one shows part of an infested leaf, seen from below, with several of the galls considerably enlarged.

Termite Societies.—Professor B. Grassi and Dr. A. Sandias have investigated the nature and origin of the Termite society in *Calotermes flavicollis* and *Termes lucifugus.* A Calotermes colony may include (*a*) indifferent larvæ, capable of becoming soldiers or sexual members; (*b*) larvæ and pupæ of sexual members with rudiments of wings; (*c*) soldier larvæ and soldiers which may arise from *a* and *b*; (*d*) winged sexual insects: (*e*) a true royal pair with vestiges of wings; (*f*) larvæ of 'reserve' sexual members and the reserve kings and queens which arise from these. These last larvæ may be developed from *a* or from various stages of *b*.

In the Termes nest there is a special caste of workers and no distinctive royal pair. The society includes (*a*) very young indifferent larvæ; (*b*) larger larvæ and the workers and soldiers to which they give rise; (*c*) winged sexual animals; (*d*) various stages of reserve and complementary sexual animals.

The one type, that illustrated by Calotermes, is founded by a king and queen, who may be replaced by a pair of reserve royal individuals, *i. e.* by a 'neotænic' couple. The second less primitive type, illustrated by Termes, contains several 'neotænic' couples, while kings are only temporary; in this case the nest arises in a secession from an older colony.

One of the most interestsng results concerns the influence of nutrition in producing polymorphism. Thus the reserve sexual members are fed not only in the larval state but afterwards from salivary secretion only, a nutritive diet which probably hastens the rapid development of the reproductive system.—*Journal Royal Microscopical Society.*

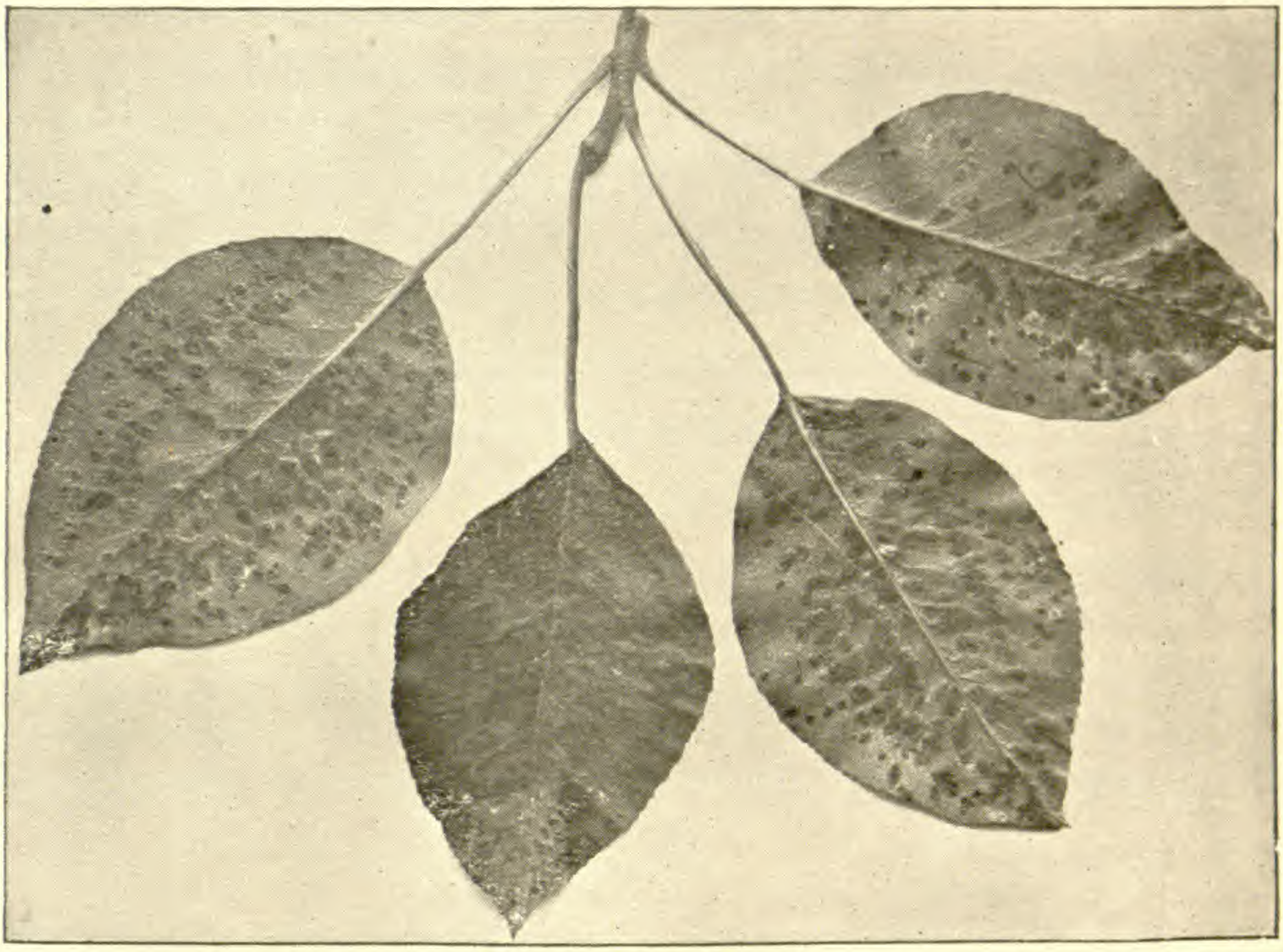
Habits of the Leaping-Ant of Southern Georgia.—In the pine forests upon the sandy loam of Thomas County, near Thomasville, Georgia, I discovered a nest of *Atta brunnea* (*Odontomachus brunneus* Roger.) No hillocks were formed, the openings to the galleries in the earth being at the surface level. The aperture was large enough to have allowed queens as large as those of *Oecodoma* to have passed, the workers (the only sex observed) of *brunnea* being much smaller. The workers jump several inches when disturbed, the leap being backwards and being caused by snapping the mandibles together.

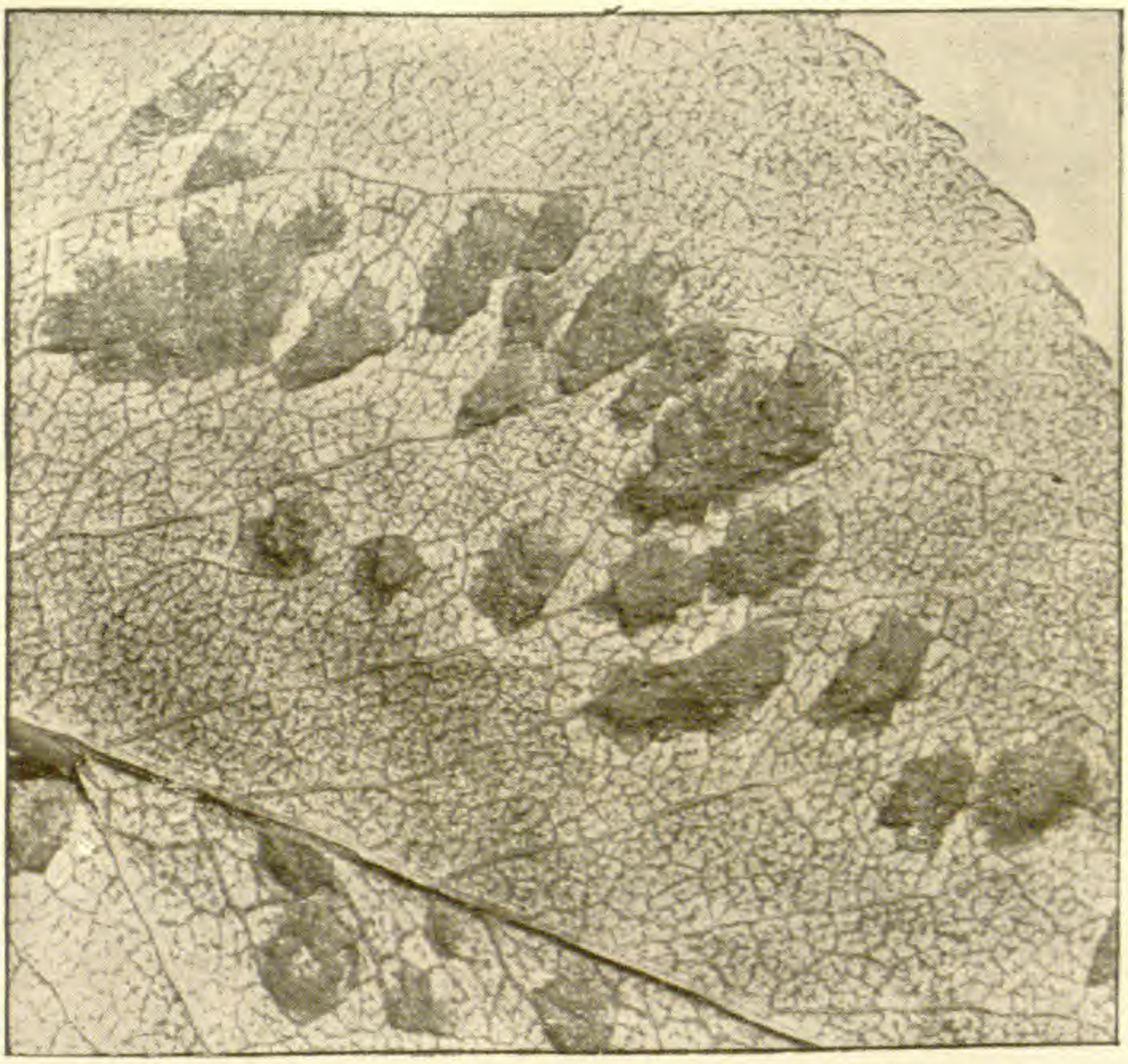
The cocoon contains the pupa of the worker in September.

Atta Brunnea (Roger). Georgia.

A. (*O.*) *hæmatodes* (L.) of the West Indies may prove to be a variety of this.

PLATE XVI.





Work of the Pear Leaf Blister Mite.

☿. Length 9 mm. Of a uniform brown color. Legs and sometimes the tip of the abdomen and the head and thorax, especially beneath, are paler. Mandibles finely serrate within; the tip tridentate, middle tooth smallest. Palpi invisible, obsolete.

Tibæ all one-spurred. Scale of the petiole produced into a spine. The thorax above is densely striate, the head above with finer striations.

ATTA CLARA Texas.

☿. Uniformly honey-yellow. Scale smaller than in *brunnea*, not forming a spine.

♂. Length. 6 mm. Head ordinary, as wide as long. Eyes oval, slightly sinuate both before and behind, black. Ocelli large, white. Antennæ long as body, not elbowed; brown, except first joint. Mandibles distant, minute, their tips touching. Palpi minute. Wings clear, veins yellow, recurrent vein received in base of second submarginal cell. Entire body and legs yellow. Abdomen hairy, second constriction deep, claspers large, scale rounded.

WM. HAMPTON PATTON, Hartford, Conn.

Note on the Winter-Ant.—Since writing the article upon this ant (AMER. NAT., Oct., '92) I have found the sexes paired in flight, at Hartford, Conn., on the third of August. This indicates the existence of a second or summer brood of the species. The male of *Prenolepis imparis* (Say) Patton, measures only about one-eigth of an inch, the female is twice as long and much more bulky. The sexes also differ in color, the males being black, the workers dark brown, and the females dark honey-yellow.

WM. HAMPTON PATTON.

PHYSIOLOGY.

Attenuation of Viper Poison.—In a commnnication published in Revue Scientifique Feb., 1894, M. M. C. Phisalix and C. Bertrand published the results of experiments made with the venom of vipers. Fresh venom from *Vipera aspis* extracted from the glands rapidly loses its virulence when subjected to a temperature of 75°–80°, and an aqueous solution so treated exhibits energetic innoculating properties against the venom itself.

They have also demonstrated that the blood of animals innoculated with this *echidno-venin* becomes antitoxic, the injection of this defibrinated blood or of the serum into the peritoneal cavity of healthy guinea-pigs, neutralized the effects of the venom.

They add that the blood of guinea-pigs protected by a poison habit, that is, by injections of pure venom in increasing quantities, administered at gradually decreasing intervals, is also antitoxic, but to a less degree than that of animals protected by vaccination. Animals protected by innoculation with antitoxic serum preserve their immunity quite a long time.

Their observations are such as lead them to believe that this antitoxic serum will prove to be a therapeutic agent.

Since then, M. Calmette, who had questioned the correctness of the results of their experiments, but who later retracted his assertions, has presented a note in which he annnounces "that one can protect animals against the venom of serpents by means of repeated doses of poison, at first weak, but gradually increasing in strength . . . . . and that the serum of the animals thus treated is at once protective, antitoxic and therapeutic." This is precisely what M. M. Phisalix and Bertrand demonstrated; but M. Calmette, not having cited their researches, they think they should lay claim to priority in publishing the important theoretical and practical consequences of this discovery, having been able to give in logical sequence the facts upon which the results are scientifically established. (Revue Sci., May, 1894).

The Secretion of Urea.—It is well known that urea exists already formed in the blood when it reaches the kidneys, and that so far as this substance is concerned, the kidneys function as eliminating organs. But in what part of the organism then is the blood charged with the urea? The researches of M. Kaufman, who has been at work at this problem for several years, have furnished results from which he draws the following conclusions:

1. The formation of urea does not take place in the liver alone; all the tissues produce a certain quantity.

2. The liver, however, is the most active secreter of urea in the young animal.

3. The production of urea seems to accompany the phenomena of nutrition which occur in the different tissues, and the phenomena of elaboration and of preparation of nutritive materials constantly poured into the blood by the liver. (Revue Sci., Mai, 1894).

ARCHEOLOGY AND ETHNOLOGY.[1]

Tobacco pipes in Shell-heaps of the St. John's.—By those familiar with the archeology of Florida, it will be remembered that the extended and careful researches of Professor Wyman among many of the shell-heaps of the St. John's river yielded no pipes, fragmentary or otherwise, intended for the smoking of tobacco, and that naturally the conclusion was arrived at by him that in all probability the makers of the shell-heaps were ignorant of its use.[2]

During the first two years of our investigations on the St. John's the negative results obtained by Professor Wyman awaited us also, though at the conclusion of our third season, in the island shell-heap constituting Mulberry Mound,[3] on the southern border of Orange County, near Lake Poinsett, we discovered at considerable depth from the surface a fragment of a tube of earthenware, which we believed, and which was pronounced by competent authority, in all probability to be a portion of a pipe used for the smoking of tobacco.

In the small burial mound situate on the northern extremity of the shell-heap we found two other fragments still more markedly indicating a similar use when entire. Nevertheless, the shell-heap fragment and those from the burial mound, assuming the contemporaneity of the two, while strong evidence as to the presence of tobacco pipes in the shell-heaps, were not final.

At the close of our fourth and last season of investigation of the river mounds (April, 1894) we again visited Mulberry Mound, making an excavation about 16 by 24 feet and 16.5 feet in depth to the water level.

At a depth of 6 feet from the surface was discovered a tobacco pipe of earthenware, complete in every part, of which we give a representation. (Plate XVII.)

Thus we have positive evidence that the men under whose feet slowly grew the great mass of powdered shell and other kitchen refuse now known as Mulberry Mound were familiar with the use of tobacco.

It is fair to explain, however, as we have previously stated in the NATURALIST, that Mulberry Mound is by no means a type of the shell-heaps of the river, since the debris of which it is composed is compara-

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

[2] "Fresh Water Shell Mounds of the St. John's River, Florida," page 59.

[3] Naturalist, Aug. 1, 1893.

tively rich in relics connecting it with a period presumably much later than most of the shell-heaps which yield little or nothing to the investigator, some even giving no evidence of the presence of sherds to the most careful and prolonged search.

The failure to find tobacco pipes in the other shell-heaps after years of investigation may at least suggest the question whether the smoking of tobacco was practiced when the older shell-heaps were made. It might be suggested, however, that, as in upwards of eighty sand mounds of the river, the majority of which were leveled to the base by us, but five tobacco pipes were met with, a proportionate infrequency of occurrence might be expected in the shell-heaps. To this we would reply that we by no means concede the contemporaneity of the sand mounds with the earlier shell-heaps; and even were a contemporary existence shown one might expect pipes, or fragments of pipes, in greater numbers in shell-heaps which represent longer periods of occupancy than in the sand mounds. The deposit of articles and certain classes of articles in the sand mounds was voluntary and dictated by custom; while into the debris of shell-heaps objects found their way through loss, if unbroken, and through rejection, if fragmentary or imperfect. Articles discovered in the shell-heaps afford a fair idea of the possessions of the men who made them. Most of us know to our cost the fragile character of a tobacco pipe of earthenware, and it is quite evident that portions of pipes accidentally broken, not to be expected in the sand mounds, since these "high places" were not used for domicile during construction, must be looked for in the shell-heaps whose makers lived upon them.

We are, therefore, of the opinion that the finding of a tobacco pipe in so exceptional and in such a presumably late shell-heap comparatively as Mulberry Mound, does not establish the use of tobacco as existing among the makers of the earlier shell heaps of Florida.

CLARENCE B. MOORE.

Norse Remains in the Neighborhood of Boston Bay.[4]— The late Professor E. N. Horsford was the first to call attention to the evidences of the truth of ancient Sagas which claim for the old Sea

[4] I received the following paper from Mr. Gerard Fowke, late of the Bureau of Ethnology, Washington, last night (June 27, 1894).

Archeology must watch with keen interest and sympathy the work undertaken by him for Miss Cornelia Horsford of excavation at the alleged sites of Norse occupation in the Charles River Valley, Massachusetts. Much discussion and prejudice has beclouded the important problem which he and Miss Horsford have

Rovers of Norway the honor of discovering America nearly five centuries before Columbus. He spent many years in this study and found dams, docks, wharves, artificial islands, ditches and canals, that could not be accounted for by any known works of either English or Indians —though this conclusion was not forced upon him until long after he had begun his investigations. With untiring industry he collected and pored over scores of ancient and almost inaccessible maps and manuscripts, and went afoot over nearly every acre for miles in the Valley of the Charles. Despite all this, his work is not known to the world at large as it should be, nor appreciated at its value outside of a very small circle of those who are ready to listen to proofs instead of dismissing as groundless statements they will not be at the trouble to verify by a slight outlay of time and labor.

Professor Horsford preferred not to make any excavations until every other source of knowledge had been exhausted; and it was not until May of this year that careful examination was made of certain places that seemed to promise good results.

Most important among these was the site of the house built by Thorfinn, who planted the first colony in A. D. 1007, within a few rods of the present site of the Cambridge Hospital. It was discovered that the foundation wall had been made by digging a trench around a rectangular space measuring about sixteen by sixty-four feet. In this trench, which was about two feet in width, were placed stones varying in size from small pebbles to boulders as large as man could readily lift, and in sufficient numbers to prevent the logs or timber resting on them from coming in contact with the earth below or at the sides; but they did not extend above the surface.

Within this foundation, at nearly equal distances from the ends and from each other, were two circular pavements some four feet in diameter, of small stones carefully laid in by hand. They were in the proper position for hearths or fire-places, but although the earth under and about them contained charcoal and ashes, the stones themselves showed no marks of heat.

The building was very similar to the long houses of the Iroquois; the same type may also be found among the timber cutters in our pine forests.

before them, but the truth will now lie with him who digs without fear or favor. If the Sea Rovers lived long there, and built many houses, if they buried many dead there, then the sure evidence of arts known and practiced by Norsemen will see the light, and Mr. Fowke will not ask his friends to agree with him till he holds such proof in his hands.

H. C. Mercer.

Another type of houses, of which there are numerous examples, consists of a cellar-like excavation in a hill side, the floor being level and the height of the back wall varying according to the slope of the hill and the size of the house.

The first of these opened is near Stony Brook Station on the Fitchburg Railway. It is just at the foot of a kame, and at a point where an ancient dam extends across a little brook a few yards away. At the front was a wall about sixteen feet long of small boulders; another wall of similar stones was a foot within this, somewhat shorter than the first and slightly curved. From the ends of these walls the ends of the hut were marked by two rows of stones at irregular intervals, four or five boulders similarly placed marking the line of the back wall. At the middle of the excavated area was a carefully placed layer of pebbles, covering a space seven feet long and three feet across. This was very probably a hearth, though as in the case of Thorfinn's house there were no marks of heat. At the left front corner of the house was a pavement four by five feet of cobblestones, extending toward the end of the dam, but not reaching to it.

A short distance from this hut site was another not more than ten feet square within the foundation walls. There was no continuous wall in this; but at each front corner three or four stones had been piled to make a support for the timbers, and a row of stones extended for five feet back from one corner. One stone at the opposite side, and two or three at the back formed the remainder of the foundation. There was a small pavement of pebbles at the center but they were not arranged in any order.

A third hut, not far from East Watertown, differed from all others opened in being narrower at the back than at the front. Boulders were at each front corner, one on each side, and two at the rear. The evidence was more distinct in this than in the others, that the roof had been of sod or turf with a covering of small stones, as the interior space was filled for more than a foot in depth with a mingled mass of black earth and pebbles that could have come only from the caving in of the top.

At several places, in the neighborhood of these houses are ancient cemeteries, most of them on sloping ground, some of them on hill sides so steep as to be difficult of ascent. The grave sites are indicated by cairns, generally about six feet in diameter, few of them varying a foot from this size. It has been generally supposed that these stone piles are due to the clearing up of the ground at some former time: but many of them are on slopes so steep that no effort at cultivation would ever be made; some are composed entirely of pebbles few of which exceed a goose egg in size while all about them are large boulders that would materially interfere with any farming operations that might be attempted. In only one of the graves opened was there any evidence of an excavation more than a few inches in the soil. It appears that the body was laid on the surface with a coveriug of brush or timber over which the stones were piled. It would seem scarcely reasonable that a people as far along toward civilization as the Norse were at that time would adopt such a mode of burial; but these cairns were beyond doubt intended for this purpose, and it must be remembered that in their native home the scarcity of soil made it necessary that corpses be thus disposed of instead of being interred. People tenaciously adhere to what is customary in such matters—as witness the wide-spread opposition to cremation.

What has been so far done in the field is only a beginning; while Professor Horsford has seemingly left little for any one else to do in collecting maps and collating the evidence of history as embodied in the Sagas, it is possible there may yet be among the old Scandinavian and Icelandic records something that will throw unexpected light on the subject. But there remains a great deal to do in the strictly archeologic line. More of the hut sites are to be excavated, and the soil immediately around them and the long houses is to be carefully examined, as there is always a possibility of the preservation of some object that will furnish indubitable proof of what is sought. This is necessary not alone in the vicinity of Cambridge, but all along the coast from Long Island Sound to the Saint Lawrence, as this whole region is said to contain to some extent remains similar to those above mentioned. A careful study is desirable also, of the sites of settlements in other countries where these people have lived; especially in Greenland whence many if not a majority of the earliest settlers of the Charles River Valley were derived.

GERARD FOWKE.

Progress of field work in the Department of American and Prehistoric Archæology of the University of Pennsylvania.—The believer in Man's great antiquity in Eastern North America is again called upon to explain a serious doubt. The easily accessible broad and well lit shelter of the Forge Cave (1 mile below Barren Springs, left bank of the New River, Pulaski County, Virginia), as explored by us in February, 1894, has astonished us again with the modern look of the evidence furnished.

Instead of several ancient midden beds interlaid with stalagmite breccia or cave earth indicating the lapse of successive epochs and the comings and goings of pre-Columbian peoples, our six-sectioned trench, 36x24x10 feet (Section 3 to rock bottom) at deepest, showed:

(1) Red earth left by nitre leachers in 1863–64, with bottle glass, nails, domestic fowl bones, etc., 15–17 inches. (White Man).

(2) Charcoal and ashes in hearth layers, sometimes invaded by diggings from above, sometimes undisturbed, with arrowheads, chips, unglazed pottery, and bone awls, 7 to 9 inches. (Predecessor of White Man).

(3) Rough, unworn blocks of limestone, larger towards the bottom, containing, for some distance down, infiltrations from layer No. 2, resting on the rock floor, 8 feet. (No trace of human or animal occupancy).

Here then, as at the Nickajack and Lookout Caves in Tennessee (explored in December, 1893), we had found but a single stratum of human occupancy (no. 2) below the superficial glass, nails and domestic animal bones of the White Man.

While in it (stratum 2), instead of a predominance of the relics of extinct or probably ancient animals bedded in the fossil preserving charcoal, we discovered the presumably modern remains (kindly identified by Professor Cope) of the Unio, Paludina, Catfish, Tortoise, Frog, Domestic Fowl, Bird (undetermined), Turkey, Marmot, Ungulate (undetermined), Beaver, Lynx, Domestic Sheep, Elk and Deer.

Only in one instance gnawed by rodents and often interlaid between undisturbed hearths, the presence and position of the bones and shells demonstrated them to be the remains of a fauna preyed upon by Man, while the 5 potsherds (3 showing decorative incisions), the 12 bone awls, the triangular chert arrowhead and infrequent hornstone chips, found in the midden layer, proved it the work of the same Indian, who, 8 miles above had scattered his riverside camp site with bones of the Deer, and had dropped pottery, earthen pipes, a polished celt, hornstone chips, and hammer stones. At a surface feasting place twenty miles below, I found the remains determined by Professor Cope to belong to the Unio, Paludina, Trypanastoma, Catfish, Turtle, Soft Shelled Turtle, Raccoon, Bear, and Deer.

This proof that no earlier people than the Indian resorted to the Forge Cave (and the Lookout and Nickajack Caverns), may indicate that no earlier people than the Indian ever inhabited the upper valleys of the New River and the Tennessee. But further search is needed to establish the conclusion, while objections to the final value of all such cave layer tests for Man's antiquity must be thoughtfully weighed.

The first is suggested by Professor Cope, that as the caves explored by me lack fossil remains, the old (Plistocene) ends of caves with their animal and, if we can believe it, human remains, have probably been worn away. Caves, therefore, would not tell the whole human, as they do not tell the whole animal story, since Man may have inhabited parts of caves which have disappeared.

This, if true, would exclude the alleged Tertiary Man of Thenay or Otta from caves, but would leave us our witnesses for any possible Plistocene blade chipper of Trenton and Madisonville.

Another objection to cave evidence is advanced by Dr. Brinton. Like the Veddas of Ceylon (who are supposed, on the authority of the brothers Sarasin, to have avoided rock shelters), early Man, he suggests, was probably *arboreal* and did not inhabit caves. But continual avoidance of available and conspicuous natural shelters by primitive peoples anywhere is hard to imagine. We have the trace of all kinds of Paleolithic, Neolithic and post-Neolithic peoples in caves in Europe and the evidence of explorers as to still existent savages visiting caves is scanty and insufficient.

If we are not hunting "Cave Dwellers," and if proof of Man's presence is all we want, then a few surface gathered trouser buttons and bottle chips will do for the White Man, arrowheads and bone needles for the Indian, and a breccia—let us suppose with Mylodon teeth and "Turtlebacks"—for some one else. Nothing short of cave avoidance by the savage will rob us of the evidence which a fire kindler or two in a century would suffice to furnish.

H. C. Mercer. March, 1894.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Entomological Society of Washington.—June 7, 1894.—The 100th regular meeting. Twenty-two members present. Mr. Charles Palm, of New York City, elected a corresponding member. President Ashmead made some brief remarks congratulating the Society upon attaining its 100th meeting and upon its prosperous career and prospects. The Recording Secretary, Mr. Howard, read a review of the work of the Society during the past ten years. Mr. Pergande presented certain additional observations upon the habits of *Ammophila gryphus* for publication. Mr. Benton read a paper entitled "Observations on the Mating of Queens of *Apis mellifica*," showing that the queens mate twice. Discussed by Messrs Riley, Gill, Schwarz and Pergande. Mr. Chittenden presented for publication some biological notes on certain Coleoptera. Mr. Schwarz presented a paper on the composition and extent of the Coleopterous fauna of Alaska, giving a lengthy outline of the history of the entomological exploration of that country, commenting upon the results of a trip taken by himself and Mr. H. G. Hubbard in 1892 through parts of Oregon, Washington and British Columbia, and showing that the Alaskan fauna predominates along the coast range of Oregon and Washington. Discussed by Dr. Gill. Mr. Schwarz also read some notes on the West Indian Sugar-cane Borer (*Xyleborus perforans*) and showed the difficulty of determining whether this insect really occurs in the United States. Discussed by Messrs Riley and Howard. Under the head of short notes and exhibition of specimens, Mr. Heidemann exhibited certain rare Pentatomids and Professor Riley announced the rearing of perfect females of Margarodes. He showed that Margarodes and Porphyrophora are synonyms.

L. O. Howard,
Recording Secretary.

N. Y. Academy of Sciences, Biological Section, May 14.—The following papers were read:—

Professor E. B. Wilson, "Experiments on the Horizontal Isotropy of the Egg;" Dr. Arnold Graf, "On the funnels and vesiculae terminales of *Nephelis*, Clepsine and Autostoma;" O. S. Strong, "On Lithium bichromate as a hardening reagent for the Golgi method."

Bashford Dean,
Rec. Sec. of Section.

Boston Society of Natural History, May 16.—The following paper was read:

Mr. A. W. Grabau: Ancient and modern channels of the Genesee River. Stereopticon views were shown.

SAMUEL HENSHAW,
Secretary.

SCIENTIFIC NEWS.

Professor G. J. Romanes.—We have to announce the recent sudden death of Professor Romanes. He was born in Kingston, Canada, in 1848, and graduated at Cambridge, England, in 1870. In 1873 he was Burney prize essayist, and Croonian lecturer in 1875. His first important investigation was on the anatomy and physiology of the nervous system of the Medusae, and he first placed our knowledge of this subject on a definite basis. His works on the evolution of mind in the lower animals and man are the best we have on the subject. He was a prolific writer on evolution, and leaned sometimes to the Neolamarkian, sometimes to the Neodarwinian opinions. In his latest work he revised the opinions of Weismann, and showed the important modifications which they have undergone. The death of Professor Romanes is a serious loss to science.

The Peary Auxiliary Expedition.—The members of this expedition dined together at St. Georges Hotel, Brooklyn, June 17th, preparatory to taking passage on the steamer Portia for St. Johns, N. B. A farewell dinner was given to Henry G. Bryant, the leader of the expedition and his colleagues at the Art Club, Philadelphia, on June 18th by the members of the advisory committee of the Geographical Club. At St. Johns they expect to be joined by the steam whaler Falcon, on which they will sail for North Greenland to look for Lieut. Peary and his party.

The members of the expedition are Professor Wm. Libbey, Jr., of Princeton University, geographer; Professor T. C. Chamberlin, of the University of Chicago, geologist; Dr. Axel Ohlin, of Sweden, zoologist; Dr. H. E. Wetherill, of Philadelphia, surgeon; H. L. Bridgman, of the Brooklyn Standard-Union; Emil Diebtsch, of Port Royal, S. C., civil engineer.

When the Portia sails to-morrow she will have on board the usual Arctic outfit of snow shoes, sledges, ice axes, tents, etc. The vessel will probably reach St. Johns about the 26th of this month, and by the 4th of July, it is thought, the Falcon will sail for the far North.

It is hoped that Peary's headquarters in Bowdoin Bay will be reached by July 25. If assured of the safety of Peary's party, some of the members of the expedition will then pay a brief visit to Ellesmere Land in their search for the missing naturalists, Bjorling and Kallstenius, who were ship-wrecked on the Carey Island two years ago.

The auxiliary expedition and the Peary party, it is expected, will leave Bowdoin Bay, September 1, and sail on the Falcon for this city, arriving here probably by the 15th of that month.

The Retirement of Professor Dana.—The resignation of Professor Dana from the position he has long held in Yale University is announced.

Professor Dana is eighty-one years of age, and is compelled to abandon further active work by feeble health. His resignation has just been accepted. He graduated from Yale in the class of 1833, returned to college as tutor and succeeded to a full professorship fifty years ago. Since then he has had charge of the department of natural science.

Born in Utica, N. Y., February 12, 1823, Dr. Dana early became interested in the researches of Professor Benjamin Silliman, and through them was attracted to New Haven. Under his guidance he was graduated from Yale in 1833 and immediately appointed instructor of mathematics to midshipmen in the United States Navy, and in this capacity visited the seaports of France, Italy, Greece and Turkey while on board the warships Delaware and United States. In 1836–38 he was assistant to Professor Silliman in the department of chemistry at Yale, and while thus engaged was appointed mineralogist and geolgist to the exploring expedition to the Southern and Pacific Oceans under Captain Charles Wilkes. He was on the corvette Peacock, wrecked at the mouth of the Columbia River. He returned in 1842 and spent some years on his portion of the report, which was partly prepared in Washington. In 1844 Dr. Dana married Professor Silliman's daughter, Henrietta Frances, and he has since continued to reside at New Haven. In 1850 Dr. Dana was appointed Silliman Professor of natural history and geology at Yale, and the same year became associate editor of the *American Journal Science and Arts,* founded by the elder Silliman in 1819. Later he became editor-in-chief, with his son, Edward S. Dana, as assistant. In 1872 the Geological Society of London conferred on Dr. Dana its Wollaston medal, and in 1877 he received the Copley gold medal from the Royal Society of London. He is a member of many of the leading scientific societies of the world, and was President of the American Association for the Advancement of Science in 1854. In 1872 the University of Munich gave him the degree of Ph. D., and in 1886 at the Harvard celebration he was awarded the degree of LL. D.

Professor Dana's principal works have been on Corals and Crustacea, and in Geology and Mineralogy. His text-books of the latter subjects are so well known as to require only mention here.

The Wistar Institute of the University of Pennsylvania.—This important addition to the many courses of the University is the gift of General Isaac J. Wistar, a son of Dr. Caspar Wistar, one of the earliest professors of anatomy at this institution. The preservation and exhibition of the Wistar Anatomical Museum is the principal object of the institute. There will also be added to it a complete collection of all objects necessary for the successful study of biology, anatomy and the historical development of the organs in man. The department will be so thoroughly equipped from a scientific standpoint that it will be used not only for purposes of exhibition but also for practical teaching. Advanced research will be the most striking feature of the work.

In connection with the institute there will be established a course of lectures which will give graduates of the medical department opportunities for post-graduate courses and deeper research in the advanced stages of anatomy and biology.

A periodical will be published, in which these subjects will be treated by men who have become celebrated because of their knowledge of these important subjects. In this building will be placed the present museum of anatomy, known as the Wistar and Horner Museum, which was presented to the University by the widow of Dr. Caspar Wistar, which gift was afterward supplemented by those of Mr. Horner. In addition to this the museum now used in connection with the Biological School will be placed in the building as soon as it is completed.

It has been decided to place the management of this institute under the direction of a Board of Managers elected by the Trustees of the University. In order that the memory of the founder of this department may be perpetuated in fitting recognition of the appreciation felt at the benevolence of General Wistar, it has been settled that one of the managers shall be a descendant of the Wistar family. The other two will be the President and Vice-President of the Academy of Natural Sciences.

The University will elect a dean of the department, who will devote his entire time and energies to the development of the manifold interests of the institute, which gives promise of being one of the greatest of its kind not only in this country, but also will rank high among similar departments in the European schools of anatomy. Fellowships will be established in order to afford deserving students ample opportunity for extended researches in this department.

Dr. Horace Jayne, the retiring dean of the college department of the University, has presented his famous anatomical collection, purchased some years ago from the renowned Collector Wade, to the Wistar Institute. The collection is composed principally of mammals, including a large number of alcoholic specimens and a complete set of rhinoceros skeletons.

Work on the building was begun less than two years ago. It is of buff brick, plainly but handsomely finished in buff terra cotta, and so constructed as to permit of additions being made with facility. The structure is thoroughly fire proof, and is provided with the most approved fire-escapes. It has a depth of sixty-six feet on Woodlaud Avenue, and a frontage of two hundred and thirty-seven feet on Thirty-sixth Street. On the latter thoroughfare is the broad entrance leading into a large vestibule eighteen by twenty feet. To the left of the entrance the curator's room is situated, and to the left is the lecture room connecting with the professor's room. The main entrance from the vestibule leads into the main hall, the dimensions of which are forty-four by thirty-six feet.

Passing through the hall to the left one will find the main museum a roomy apartment of fifty by one hundred and ten feet, furnished throughout with all the appliances necessary for an institution of the sort. Two smaller rooms toward the Spruce Street end are reserved for the reception of private collections.

The second floor will be devoted principally to work-rooms and professors' apartments. It will also contain a library and a museum corresponding in size to the one on the lower floor. Three more work-rooms are located on the third floor, with quarters for the janitor. There will also be another museum formed of galleries eighteen feet wide, overlooking the similar department on the floor below.

The basement will be devoted exclusively to work-rooms, all of which will be furnished with zincs, flues and other appliances necessary for dissecting work. The height of the basement is twelve feet, and that of the other floors, fourteen, twelve and twelve respectfully.

At the opening exercises, there was a fair assemblage notwithstanding the very unfavorable weather. Addresses were made by Provost William Pepper, Director Harrison Allen, M. D., and Professor William Osler, M. D., of John Hopkins, formerly of the University of Pennsylvania.

Major J. W. Powell has resigned from the Directorship of the U. S. Geological Survey, and Mr. C. D. Walcott has been appointed by the President and Senate to take his place.

Professor H. S. Williams formerly of Cornell University, takes the place of Professor J. D. Dana in Yale University.

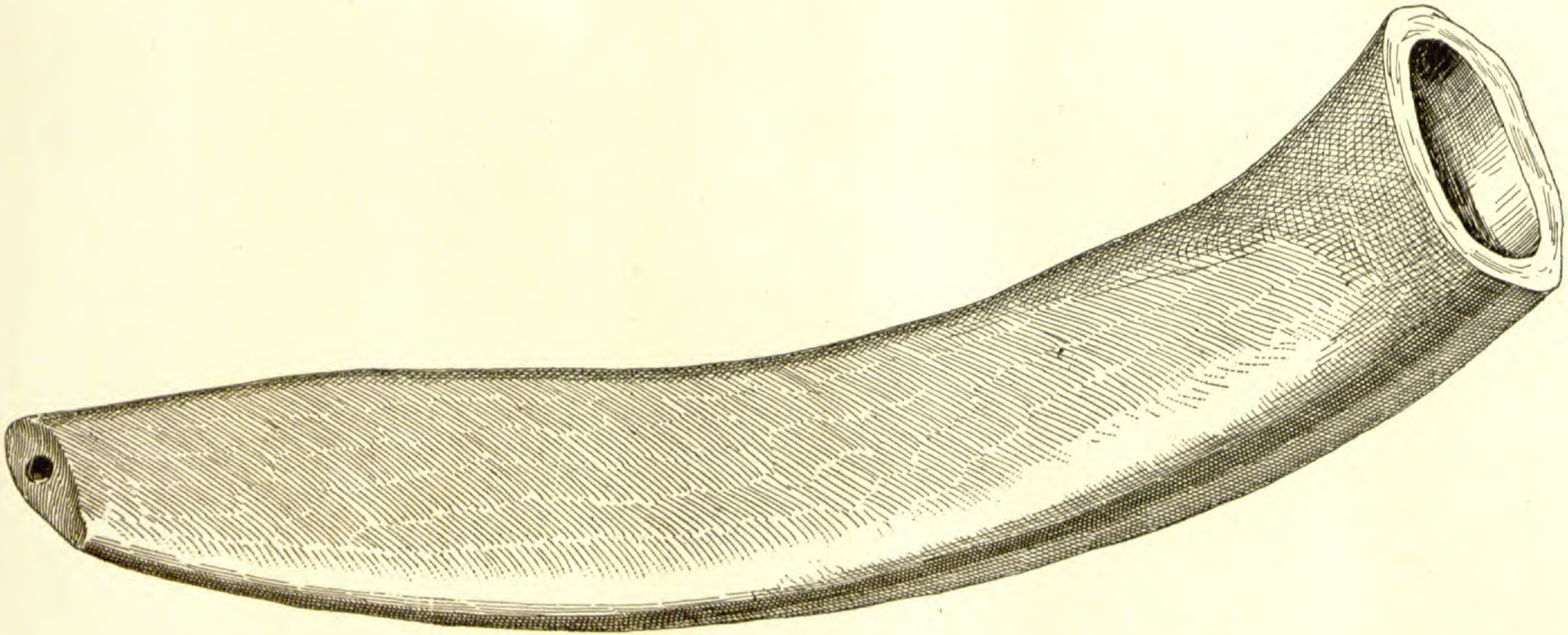
Among the books announced by MacMillan & Co. for early publication are:—"A three months course of practical instruction in Botany" by F. O. Bower; a "Course in Experimental Psychology" by J. McK. Cattell; "Physiology for Beginners" by Michael Foster; "Methods of Histological Research" by C. von Kahlden, translated by C. Morley Fletcher; "Text-book of Invertebrate Embryology" by Korscheldt and Heider, translated by E. L. Mark and W. M. Woodworth; "Lectures on Human and Animal Psychology" by Wilhelm Wundt, translated by J. E. Creighton and E. B. Tichener; and a series, the "Cambridge Natural Science Manuals" edited by A. E. Shipley and containing "Elementary Paleontology—Invertebrate" by Henry Woods; "Practical Physiology of Plants" by F. Darwin and E. H. Acton; "Text-book of Physical Anthropology" by Alex. Macallister; "The Vertebrate Skeleton" by S. H. Reynolds; "Fossil Plants" by A. C. Seward; and "Elements of Botany" by F. Darwin.

We regret to learn that our contemporary "Science" has suspended publication for want of sufficient financial support.

The Philadelphia Zoological Garden has received specimens of the Indian cats, *Felio bengalensis* and *F. viverrinus*.

Errata in June NATURALIST.—For Fig. 4, p. 530, read Fig. 2. For Fig. 2, p. 529, read Fig. 3. For Fig. 3, p. 530, read Fig. 4.

PLATE XVII.



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THE AMERICAN NATURALIST

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THE ORIGIN OF THE VERTEBRATE SKELETON.

By J. S. Kingsley.

Until a very recent date, not a doubt existed that any part of the vertebrate skeleton was of other than mesodermal origin. The cartilages were mesoderm, and in their further development the cartilages were transformed into bone by means of the cells from the same parent layer. The membrane bones of the skull were also believed to mesodermal, since the researches of Oscar Hertwig ('74) had shown that in the Batrachia especially, as well as in other forms, they arose from the layer which formed the dentine of the teeth, and which was homologous with that which formed the dentine of the placoid scale. The details of this need not be given here, as they will will be found in every text-book; the point to be emphasized is that dentine and its homologue membrane bone were assumed to be, and even thought to be proved to be, of mesodermal origin.

One of the first papers to lay a foundation for a different view was one by Kastschenko ('88), which, while saying nothing of the origin of the skeleton, pointed out that certain parts of the mesenchyme were of ectodermal origin. Next, another Russian, Goronowitsch ('92), showed that in the formation of the "ganglionic folds" into the head, not all the tissues proliferated from the ectoderm into the "ganglienleisten" was used up in the formation of nervous matter, but that some of it became mesenchymatous and was possibly utilized in the development of the skeleton. Other authors at about the same time confirmed more or less clearly this view that all mesenchyme was not of entodermal, but that at least some of it was ectodermal, in origin.

In 1893, Miss Julia B. Platt, in a preliminary paper, made the noteworthy statement that the embryology of Necturus showed that, at least in the head, the cartilages were derived from the ectoderm. Necturus was especially favorable in this respect, for its cells are larger and pigment is absent. At about the stage of the formation of the ganglienleisten, the differences between the entoderm and mesothelial tissues on the one hand, and the ectoderm on the other, were very great, the former being loaded with yolk granules, the latter containing comparatively few. Further, the layers readily differentiated by staining with the Erlich-Biondi mixture. With the formation of the ganglienleisten from the ectoderm, its cells could be distinguished in the same way, and it was found that only the dorsal portion of ridge becomes nervous, the lower contributing its cells to the mesenchyme, while between the two regions there was a portion which contributed to both tissues. These ectodermal mesenchymal parts (mesectoderm, as Miss Platt calls them) can readily be distinguished after their separation from the parent layer by the peculiarities already mentioned. From these proliferations tissue arises which later forms the gill cartilages, while further in front, near the eyes and the nose, similar ingrowths are seen, and especially in the region where the mouth is to break through. From these last arise at least the trabecular cartilages; the origin of the parachordals and otic capsule is not given.

In a second paper ('93[a]), Miss Platt further elaborates some of her earlier statements, illustrating the parts with three figures, one of which shows the downward growth of the mesectoderm, to use her extremely convenient term, between the gill clefts and in the region of eye and nose.

Before the appearance of Miss Platt's second paper, Goronowitsch published his detailed account ('93), fully confirming the statements of his preliminary, and showing that ectodermal ingrowths occur in the birds in just such positions as to justify the view that they gave rise to skeletal structures. Some of these, according to Goronowitsch, found their destiny in the cutis, a fact to be remembered while considering the work of Klaatsch, outlined below. A little later (93[a]) Goronowitsch published a short note in which, among other points, he claimed that Miss Platt had not made good her thesis that these mesectoderm cells gave rise to the cartilage. Miss Platt's final paper will, we understand, soon appear.

The most important and most detailed paper of all is that of Klaatsch, which appeared in April of this year. Its title—" On the Origin of the Scleroblasts. A Contribution to the Knowledge of Osteogenesis "—shows its scope. We can give but the merest outline of the points detailed in the 90 pages of the paper.

The first point considered is the development of the placoid scale. This, as is well-known, consists of two portions, a harder outer portion, the enamel secreted by the basal ends of cells of undoubted ectodermal origin; and a deeper dentine which, up to now, has been universally regarded as of true mesodermal nature. Klaatch studied the development of the placoid organ in several species of Acanthias, Mustelus and Heptanchus. These presented various differences, but in general, they agreed in the following features. In the earlier stages the ectoderm is two cells in thickness, a flattened superficial layer and a deeper cubical or columnar layer. Between this last and the corium is a clear space, and there is no continuous basal membrane. A little later this deeper layer begins to undergo modifications, cells being budded from it into the clear space. These cells are readily seen to belong to the ectoderm, not only from the directions of the mitotic spindles, but from the fact that their nuclei are greatly larger than those of the corium, the only other layers from which they could arise. These cells are the scleroblasts. They are not scattered irregularly through the clear space, but are more abundant in some places than in others, thus early marking out the positions of the later placoid organs. With the modifications of the ectoderm described by Klaatsch, we have nothing to do here further than is concerned in the scale development. It is to be noticed that along with the formation of the little patches of scleroblasts the overlying cells of the basal layer become elongated, the first step in the development of an enamel organ. The later stages in their general features are much as described by Oscar Hertwig in his classic paper of twenty years ago, and yet there are important differences to be noted. The heaping up of the scleroblasts continues, the result being the formation of the dentine organs, carrying with it the superposed enamel cells in the form of a pyramid. The enamel organ is terminated on all sides by a groove, and even at this stage the cells at the bottom of this groove are actively engaged in proliferating additional scleroblasts which are pushed into the still-growing dentine organ. The necessary conclusion is not only is the enamel of the placoid scale an ectodermal derivation, but such is the nature of the dentine as well.

Now placoid scales and teeth have long been regarded as homologous structures, and so Klaatsch studies the history of the latter. In the sharks he finds that the conditions of the development of the scales are paralleled in the ontogeny of the teeth. There is the same early proliferation of scleroblasts into the clear layer, and later, when the enamel cap is formed, its limiting groove is the seat of additional ingrowth of dentine-forming cells. In short, we must no longer regard the teeth as structures derived from two germ layers—ectoderm and mesoderm—but as purely ectodermal products.[1]

In the fin of the shark are numerous horny rays, and their history is followed. Earlier workers had universally regarded them as belonging to the connective-tissue series, although in 1885 Krukenberg had shown that their organic base was different from the chemical standpoint from the other connective tissues. Klaatsch finds that here there is a similar inwander-

[1] It is to be noted that in the recent meeting of the Anatomische Gesellschaft at Strassburg, May 13–16, Professor Rabl had a paper "Ueber die Herkunft des Dentinkeims in den Placoidschuppen und den Zähnen der Selachier (gegen Klaatsch)." The publication of this will be waited with interest.

ing of ectoderm cells into the region between the basal epithelium and the corium. From these cells are produced at first extremely minute horny rods, and these, later, together with their parent cells, sink through the corium into the position they finally occupy, where no one, not tracing their history in detail, would suspect their ectodermal origin. Even in Torpedo, where no horny rays occur in the paired fins of the adult ingrowths of ectoderm into the axial portions of the fin exist. At this point one author supports Rabl in his view that the unpaired fins are not derived from the fusion of paired rudiments. The opposite view is fastened upon Dohrn, regardless of the fact that it was first shown to be probable by J. K. Thacher and later supported by Balfour. Dohrn's special contention was that the fins, paired and unpaired, were derivatives of the parapodia of the worms, and later, Paul Mayer claimed to have found structures—"parapodoids"—which represented these. These "parapodoids" are, according to Klaatsch's view, the early placoid organs.

In studying the development of true bone, Klaatsch studied *Salmo salar*. Here the earliest to appear were the opercular bones, and but little later those of the shoulder girdle and those arising in connection with the teeth, later those of the cranium. The details of the formation of the scleroblasts for a few of these bones is given, including the squamosal, operculum, clavicula, dentary, and the osseous fin-rays. In the case of each, the osteoblasts are derivatives of the ectoderm. The squamosal is especially interesting, since it begins from outgrowths at the point of the infolding of the mucous canals, and is developed in connection with these organs. At first it is connected solely with them, and is plainly a membrane bone; later it comes into contact with the otic capsule. Klaatsch sides with those who would make no sharp distinction between cartilage- and membrane-bones, and regards not only the squamosal but the cranial roof and the ossifications which appear in the cranial roof and on the primordial cranium as having their origin in bones developed, like the squamosal, for protection of the cutaneous sense-organs.

After discussing these, Klaatsch passes to the bony fin-rays of the Teleosts and then to their scales, giving details which our space will not allow us to repeat, but in each case he comes back to the conclusion that in each and every case the so-called mesodermal element is of ectodermal origin. Then a few instances are taken from other groups—Salamandra and Lepus. In the Batrachia he finds the same conditions as in sharks and Teleosts. In the Mammals he fails to trace the history of his scleroblasts, but he finds here, as elsewhere, proliferations of ectodermal cells into the subadjacent tissues, which, it is possible, may later form the skeletogenous cells.

It needs hardly be said that these various contributions thus superficially summarized are most important, since, if they be confirmed, they will tend to an overthrow of many ideas long believed to be firmly grounded. The questions concerned are far from settled, but we venture to predict that the subject will occupy a prominent place in the morphological literature of the immediate future.

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VARIATION OF NORTH AMERICAN FISHES.*

I.

THE VARIATION OF ETHEOSTOMA CAPRODES RAFINESQUE.

BY W. J. MOENKHAUS.

Etheostoma is a genus of American Freshwater Percidæ. It consists of about 100 species distributed in a number of subgenera. All the members of the genus are small. They are distributed over approximately the entire Atlantic slope of North America. The northernmost points are Fort Quappelle and Montreal; the southernmost, Chihuahua. The most western points are Colorado and Swift Current in Canada near the 108th meridian.

The subgenus Percina includes the largest of the darters. There are but two well-defined species. One, *Etheostoma rex* is known from east of the Alleghany Mountains. The other, *Etheostoma caprodes* is also found east of the Alleghanies, but its chief habitat is west of these mountains, where it is found from Lakes Champlain and Superior to the Rio Grande.

This latter species, *Etheostoma caprodes* Rafinesque, has been studied with a view to ascertain the extent of its variation, the relation of its variation to its geographical distribution, the extent of variation in each locality, and the variation with age. This species of the darters has been selected for its size, and on account of its wide distribution and moderate abundance within its limits. Its variability has been known for a long time, and has given it a number of specific names.

The material examined is recorded in the table of measurements and counts.

The greatest variation was found to be in the color. Slighter variations were found in proportions and number of fin rays.

*Contributions from the Zoological Laboratory of Indiana University, under the direction of Carl H. Eigenmann, No. 10.

Evolution of the Color Pattern.

As just stated, the point of greatest variability is the color pattern. The colors in life are not taken into consideration, but only the black markings which were preserved in alcoholic specimens. On comparing living specimens with alcoholic material, but little difference was noticed. In the matter of color patterns, the specimens from any one locality agree to a remarkable extent. This statement refers only to specimens of the same size—differences, of course, existing between young and adult stages.

The simplest pattern was found in specimens from Chocola Cr., Ala. These were immature specimens, and do not represent the adult condition.

In these specimens (30 and 33 mm. long., fig. 1), we have a series of nine cross-bars extending from the back to below the middle of the sides. The bars at the ends of the dorsal fins are much emphasized, and all the bars are heaviest at their upper and lower ends. There is a distinct round spot at the root of the caudal. The color of the head need not be taken into consideration in this specimen. The caudal spot remains in all the specimens examined. The most complicated pattern, that of fig. 7, is shown to be derived by easy stages and step by step from the condition figured in fig. 1.

The simplest pattern in adult fishes is found in specimens inhabiting the waters of the Wabash River and its tributaries in Indiana (Nos. 9, 40 and 44). The pattern here consists of a series of long and short bars alternating. In the anterior region, the short bars are usually as long as the long bars. A better way to designate these is to term the long bars "whole bars," and the short bars "half bars." The whole bars towards the posterior end of the body spread slightly and become more intensely colored toward their ventral extremity. The black caudal spot is also present here. This spot does not vary in any of the patterns figured. The head is colored black above, and has a large spot on the opercle, taking the general form of the opercle itself. The color on the top of the head is most intense towards the posterior, as shown in fig. 9, and becomes less less distinct as it extends forward to the tip of the snout.

Around the eyes are seen faint indications of three bars: one extending forward; the second downward, and the third backward (fig. 2).

Comparing this pattern with the one in the young, we find that the whole bars are homologous in the two, and that the half bars have been added.

A step in advance is taken by the adult specimens from Chocola Cr., Ala., fig. 3 (Nos. 76–82). These have the bars alternately long and short along the entire length of the body. The bars are considerably broader and more intense, and the whole bars have their ventral extremities much broadened, so as to form quite an apparent series of spots along the side. An additional half bar is added by the union of the spot above and the spot just in front of the black caudal spot. Here the three bars radiating from the eye are somewhat more distinct than in the pattern already described.

The next series of individuals are Nos. 45–55, 72, 73 and 75, in the list given below, and are represented by fig. 4. They are found in the Green, Cumberland, Tennessee and Arkansas River Basins. The color pattern here shows a greater irregularity in its bars, and has developed in addition a still shorter between each of the whole and half bars of the preceding pattern, so that we have now whole, half and quarter bars. The series of lateral spots is present only along a part of the body. The bar extending anteriorly from the eye is broken into two shorter and less distinct ones.

Of considerable significance in the specimen figured in fig. 3 is the fact that in the bar between the dorsals, we have a notch indicating that some of the color-cells are separating from the whole bar. A similar condition is shown in the same region of fig. 4. The quarter bars are apparently split off from the other bars. It is of interest that variations in the direction of an increased number of bars is always, as far as my specimens go, introduced at this point. Specimens intermediate between this and the preceding form show that the quarter bars always make their first appearance between the seventh and eighth whole bars and the included half bar.

Other quarter bars are then added in front and behind this region.

From the conditions represented in fig. 3, we have two diverging lines of development. The one line was discussed in the preceding paragraph. The other line is found in specimens, Nos. 82 and 83, taken from San Marcos Spring, Texas, and is represented in fig. 5. We have here a splitting of the bars without the regular result seen in fig. 4. The lower ends of the whole bars have not split, in fact, they have increased in width, and form a very prominent series of spots along the side. It will be seen that the bars radiating from the eye have become much more pronounced.

The pattern of fig. 6 can be easily derived from the preceding one by assuming that the lower half of the whole bars of the anterior part of the body have shifted their position backward, so that they no longer extend extirely to the mid-dorsal line. The 3d, 4th and 5th whole bars show different degrees of shifting. The lower part of the 4th has shifted, but still retains its connection with the upper part. In the 3d, the bar is more nearly separated, while in the 5th the separation is complete, and the original lower part of the bar becomes simply a vertically elongated spot. The bars around the eye are here again less developed. The pattern of fig. 6 is the one occurring in *Etheostoma caprodes manitou* Jordan, and was drawn from a specimen taken from Torch Lake, Mich. Other specimens, taken from the same lake and from other localities, have the same color pattern with slight variations. Nos. 1–7, and 41 of Table I, are this variety.

The line of development taken up by fig. 5 is continued in figs. 7 and 8, representing the specimens from Obey's River and Eagle Creek in Tennessee, and from the Little South Fork of the Cumberland River in Kentucky. These are Nos. 56–72 in the table. A single young specimen, No. 74, which promised to become this form, was also taken in the North Fork of the Holston River, in Virginia. The two figures were drawn from a younger and older specimen respectively, of the same form. In the younger specimens, the bars have become more split up, and have increased in irregularity. Almost all of the original bars, however, can be traced. The lateral spots, too, are much more prominent than in the preceding pattern. In the older individuals the bars have become so much split up as to form a complicated network, and the original pattern can be made out only in a general way. The spots are larger and darker than in the younger, and form almost a continuous lateral band. The radiating bars around the eyes are correspondingly more developed, the one extending backward in a slight curve beyond the head to the first lateral spot.

In the last pattern, the original simple whole and half bars have reached their greatest modification, and the faint lateral spots of fig. 2 have become the most prominent part of the coloration.

The variation presents a serial modification in two divergent lines from an original simplest pattern. Beginning with the whole bars of fig. 1, we pass to the form having alternate whole and half bars, and an imperfect series of lateral spots. From this form we pass on the one hand to the pattern having alternate whole, half and quarter bars, and on the other hand to the pattern consisting of reticulated markings above, and a very prominent series of spots along the sides. In the pattern of fig. 6, we have a second divergent line of development from fig. 5. The radiating bars around the eyes become more developed as we pass from the simple to the more complex patterns, with the exception in fig. 6.

It will be seen from the localities at which each of the various patterns occurred, that there is no definite serial relation between the variations and the latitude at which they are found. As already stated, however, the variations are remarkably definite for a given locality. The specimens from the Wabash waters can, almost without exception, be distinguished from those of the Cumberland River, for instance, while those from the Alabama River are distinguished by their invariably broader bars. Both the patterns of figs. 4 and 6 occur in the Cumberland and Tennessee River system, but both have not been taken from the same tributaries of these streams.

The color pattern of *Etheostoma caprodes* is of interest when considered as to its bilateral symmetry. In most of the simplest patterns, the corresponding bars on the two sides are exactly alike, and precisely meet each other in the mid-dorsal tine. This almost perfect symmetry is not so prevalent in the more complex patterns. The simplest cases of asymmetry are found in the simplest patterns when some of the bars do not exactly meet their fellows on the back. Fig. 8 shows an instance of this kind. Both the asymmetrical and the symmetrical forms occur in the same locality, and the former seems purely accidental, but in all cases observed, it makes its first appearance in the bars along the spinous dorsal. From this point it spreads backward along the soft dorsal until we reach an extreme form of asymmetry, as represented in fig. 9. Here the first three and the last four bars, together with the bar between the dorsals, still preserve their symmetry, while those along the entire length of both dorsals are quite asymmetrical.

In regard to variations in parts other than in the color pattern, only those points of structure were examined that could be most accurately made out on alcoholic specimens. One very marked departure from the regular form exists in the specimens from San Marcos Spr., Texas. This departure consists, as shown in fig. 5, of an increase in the depth of the body in the region of the spinous dorsal, as a result of the unusual elevation of the back in this region. These belong to the variety carbonaria, described from Texa, and are more distinct in points of form than the varieties I examined from any other locality.

No. 8 in Table I, taken by Dr. Meek at Cedar Rapids, Iowa, differs materially from any of the specimens from other localities. It approaches nearest the variety zebra in the color pattern, and in having no scales before the spinous dorsal. The scales, however, are larger, there being but 76 in the lateral line. The head measures $3\frac{1}{2}$ in body and the number of rays in anal is 12.

The following table will give the number of specimens, their locality and the points of structure which have been examined. The spines in the dorsal and anal fins are indicated by Roman numbers and the rays by Arabic numbers. The length of the specimens are measured in mm. from the tip of the snout to root of caudal. Only those scales of the lateral line are counted which have the tribes developed in them. The localities are arranged in the order of their latitude from north to south.

TABLE I.

LOCALITY.	Figures representing these types.	Length of body in mm.	Length of head in mm.	Head in body.	Dorsal fin.	Anal fin.	Scales in lateral line.
1. Torch Lake, Mich.	6	77	19	$4\frac{1}{19}$	XIV,15	II,10	90
2. " " "	6	76	19	4	XIV,15	II,10	90
3. " " "	6	80	20	4	XV,15	II,10	85
4. " " "	6	75	$18\frac{1}{2}$	$4\frac{1}{18}$	XV,15	II,10	89
5. " " "	6	80	20	4	XV,15	II,10	90
6. " " "	6	77	19	$4\frac{1}{19}$	XIV,14	II,10	90
7. " " "	6	73	18	$4\frac{1}{18}$	XV,16	II,11	90
8. Cedar Rapids, Iowa	6	70	20	$3\frac{1}{2}$	XIV,15	II,12	76
9. White River, Indianapolis, Ind.	2				XIV,16	II,10	86
10. Racoon Creek, Mecca, Ind.	2	40	$10\frac{3}{4}$	$3\frac{9}{10}$			89
11. " " " "	2	42	11	$3\frac{9}{11}$			90
12. " " " "	2	41	11	$3\frac{8}{11}$			90
13. Gosport, Ind.	2	90	21	$4\frac{2}{7}$	XV,15	II,10	90
14. " "	2	50	13	$3\frac{11}{13}$	XIV,15	II,10	88
15. " "	2	38	10	$3\frac{4}{5}$	XV,15	II,10	90
16. " "	2	47	13	$3\frac{8}{13}$	XV,15	II,10	87
17. " "	2	53	14	$3\frac{11}{15}$	XV,15	II,10	90
18. Bean Blossom, Ind.	2	67	17	$3\frac{16}{17}$	XV,16	II,10	87
19. " " "	2	84	22	$3\frac{4}{11}$	XIV,16	II,11	90
20. " " "	2	94	24	$3\frac{11}{12}$	XIV,17	II,11	88
21. " " "	2	$86\frac{1}{2}$	$22\frac{1}{2}$	$3\frac{9}{22}$	XV,16	II,11	85
22. " " "	2	83	21	$3\frac{20}{21}$	XIV,16	II,11	86
23. " " "	2	113	27	$4\frac{5}{27}$	XV,15	II,11	86
24. " " "	2	$71\frac{1}{2}$	$18\frac{1}{2}$	$3\frac{17}{18}$	XIV,16	II,10	88
25. " " "	2	82	$21\frac{1}{2}$	$3\frac{16}{21}$	XIV,16	II,10	87
26. " " "	2	77	21	$3\frac{2}{3}$	XV,16	II,11	88
27. " " "	2	71	18	$3\frac{8}{9}$	XIV,16	II,11	88
28. " " "	2	61	16	$3\frac{3}{4}$	XV,16	II,10	87
29. " " "	2	44	11	4	XIV,16	II,11	85
30. " " "	2	42	11	$3\frac{9}{11}$	XV,16	II,10	86
31. " " "	2	47	13	$3\frac{8}{13}$	XIII,16	II,10	85
32. " " "	2	96	24	4	XV,15	II,11	88
33. " " "	2	73	18	$4\frac{1}{18}$	XIV,16	II,10	85
34. " " "	2	68	17	4	XIV,16	II,10	86
35. " " "	2	35	10	$3\frac{1}{2}$			
36. " " "	2	33	9	$3\frac{2}{3}$			
37. Rushville, Ind.	2	88	22	4	XIV,15	II,10	90
38. Wild Cat Creek, Kokomo, Ind.	2	130	32	$4\frac{1}{16}$	XV,16	II,11	85

Locality.	Figures representing these types.	Length of body in mm.	Length of head in mm.	Head in body.	Dorsal fin.	Anal fin.	Scales in lateral line.
39. Pike Creek, Ind.	2	107	26	$4\frac{3}{26}$	XIV,16	II,11	89
40. " " "	2	102	25	$4\frac{2}{25}$	XV,16	II,11	91
41. Illinois	2	65	15	$4\frac{1}{3}$	XV,14	II,10	89
42. Nipisink Lake, Ills.	2				XV,15	II,10	85
43. " " "	2				XIV,15	II,11	85
44. Monongahela River, Pa.	4	96	23	$4\frac{2}{23}$	XV,15	II,10	85
45. Hartford, Ky.	4	76	19	4	XVI,14	II,10	88
46. " "	4	76	19	4	XV,15	II,10	87
47. " "	4	76	19	4	XIV,16	II,10	88
48. " "	4	78	$19\frac{1}{2}$	4	XV,16	II,11	90
49. Green River, Greensburg, Ky.	4	85	20	$4\frac{3}{20}$	XV,15	II,10	89
50. " " " "	4	90	$21\frac{1}{2}$	$4\frac{4}{21}$	XV,16	II.11	92
51. " " " "	4	77	$17\frac{1}{2}$	$4\frac{7}{19}$	XV,15	II,11	85
52. Little Barren River, Osceola, Ky.	4	92	23	4	XV,15	II,11	89
53. " " " " "	4	69	17	$4\frac{1}{17}$	XV,14	II,11	89
54. " " " " "	4	69	17	$4\frac{1}{17}$	XVI,15	II,11	89
55. " " " " "	4	69	17	$4\frac{1}{17}$	XIV,16	II,11	83
56. Little S. Fork Cumberland River, Wayne Co., Ky.	7 & 8	103	25	$4\frac{1}{8}$	XVI,15	II,11	92
57. Eagle Creek, Olympus, Tenn.	7 & 8	82	21	$3\frac{19}{21}$	XVII,14	II,11	87
58. " " " "	7 & 8	$61\frac{1}{2}$	16	$3\frac{13}{16}$	XVI,15	II,11	92
59. Obey's River, " "	7 & 8	77	18	$4\frac{5}{18}$	XVII,14	II,11	89
60. " " " "	7 & 8	86	21	$4\frac{2}{21}$	XV,14	II,10	86
61. " " " "	7 & 8	55	$13\frac{1}{2}$	$4\frac{1}{13}$	XVI,15	II,12	89
62. " " " "	7 & 8	66	17	$3\frac{15}{17}$	XVI,15	II,12	90
63. " " " "	7 & 8	62	15	$4\frac{2}{15}$	XVII,15	II,12	87
64. " " " "	7 & 8				XVII.15	II,11	90
65. " " " "	7 & 8	65	$16\frac{1}{2}$	$3\frac{15}{16}$	XV,17	II,11	90
66. " " " "	7 & 8	53	14	$3\frac{11}{14}$	XVI,15	II,11	89
67. " " " "	7 & 8	54	$13\frac{1}{2}$	4	XVII,15	II,12	86
68. " " " "	7 & 8	60	15	4	XVII,15	II,12	91
69. " " " "	7 & 8	$51\frac{1}{2}$	$12\frac{1}{2}$	$4\frac{1}{12}$	XVII,14	II,12	85
70. " " " "	7 & 8	$53\frac{1}{2}$	13	$4\frac{1}{13}$	XVII,15	II,12	89
71. " " " "	7 & 8	$57\frac{1}{2}$	$14\frac{1}{2}$	4	XVII,15	II,11	90
72. Watauga River, Elizabethtown, Tenn.	4	122	27		XVI,16	II,11	92
73. " " "	4	94	21		XV,16	II,10	92
74. North Fork Holston River, Saltville, Va.	7 & 8	$47\frac{1}{2}$	13	$3\frac{9}{13}$	XVI,15	II,12	92
75. Eureka Springs, Ark.	4	112	24	$4\frac{2}{3}$	XVI,15		
76. Chocola Creek, Oxford, Ala.	3	94	21	$4\frac{10}{21}$	XVI,15	II,11	91
77. " " " "	3	97	18	$4\frac{5}{18}$	XV,17	II,12	78
78. " " " "	3	89	21	$4\frac{5}{21}$	XVI,17	II,11	93
79. " " " "	3	78	17	$4\frac{10}{17}$	XV,15	II,11	90
80. San Marcos Spring, Texas	5	95	21	$4\frac{11}{21}$	XIII,15	II,11	85
81. " " " "	5	102	24	$4\frac{1}{3}$	XIV,15	II,11	93
82. " " " "	3	27	7	$3\frac{6}{7}$			
83. " " " "	3	30	8	$3\frac{3}{4}$			

Table II presents all the combinations of dorsal spines and dorsal rays, and the number of specimens having the given combination. (But 76 of the specimens have been examined for this table.) The combinations are arranged in the numerical order of the spines from the lowest number to the highest. In the third column are given the per cents. of specimens having each combination. XV, 15 is seen to be the commonest combination; XIV, 16 the next, XV, 16 and XVI, 15 the next, and so on. The largest per cent. of any combination does not exceed 21.052.

TABLE II.

Dorsal Fins.	Number of specimens.	er cent. of specimens.
XIII, 15	1	1.315
XIII, 16	1	1.315
XIV, 14	2	2.631
XIV, 15	6	7.895
XIV, 16	12	15.789
XIV, 17	1	1.315
XV, 14	3	3.947
XV, 15	16	21.05
XV, 16	11	14.47
XV, 17	2	2.631
XVI, 14	1	1.315
XVI, 15	9	11.841
XVI, 16	1	1.315
XVI, 17	1	1.315
XVII, 14	3	3.947
XVII, 15	6	7.894

In Table III are arranged the varieties in the number of dorsal spines, the number of specimens representing each variation, and the per cent, of all the specimens for each variation. The average number of spines is $15\frac{5}{76}$, while the number of spines predominating is 15.

TABLE III.

Dorsal Spines.	Number of specimens.	Per cent. of specimens.
XIII	2	2.631
XIV	21	27.63
XV	32	42.11
XVI	12	15.789
XVII	9	11.841
Average number of spines		$15\frac{5}{76}$

In Table IV the same data are given for the dorsal rays. The average number of rays is $15\frac{6}{19}$, about the same as the spines. Fifteen is seen to be the number in about 50 per cent. of all the specimens examined. While 42.11 per cent. have fifteen dorsal spines, and 50.007 per cent. have fifteen dorsal rays, only 21.05 per cent. have a combination of fifteen spines and fifteen rays.

TABLE IV.

Dorsal Rays.	Number of specimens.	Per cent. of specimens.
14	9	11.841
15	38	50.007
16	25	32.90
17	4	5.262
Average number of rays		$15\frac{6}{19}$

The variations in the anal fin are given in Table V. The anal fins of only 76 specimens were examined.

PLATE XVIII.

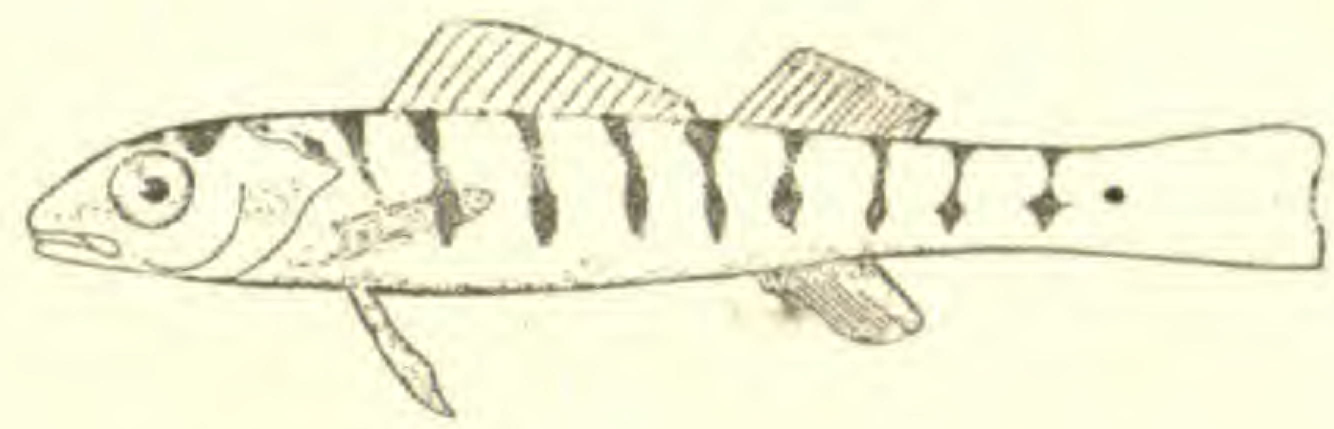


FIG. 1.

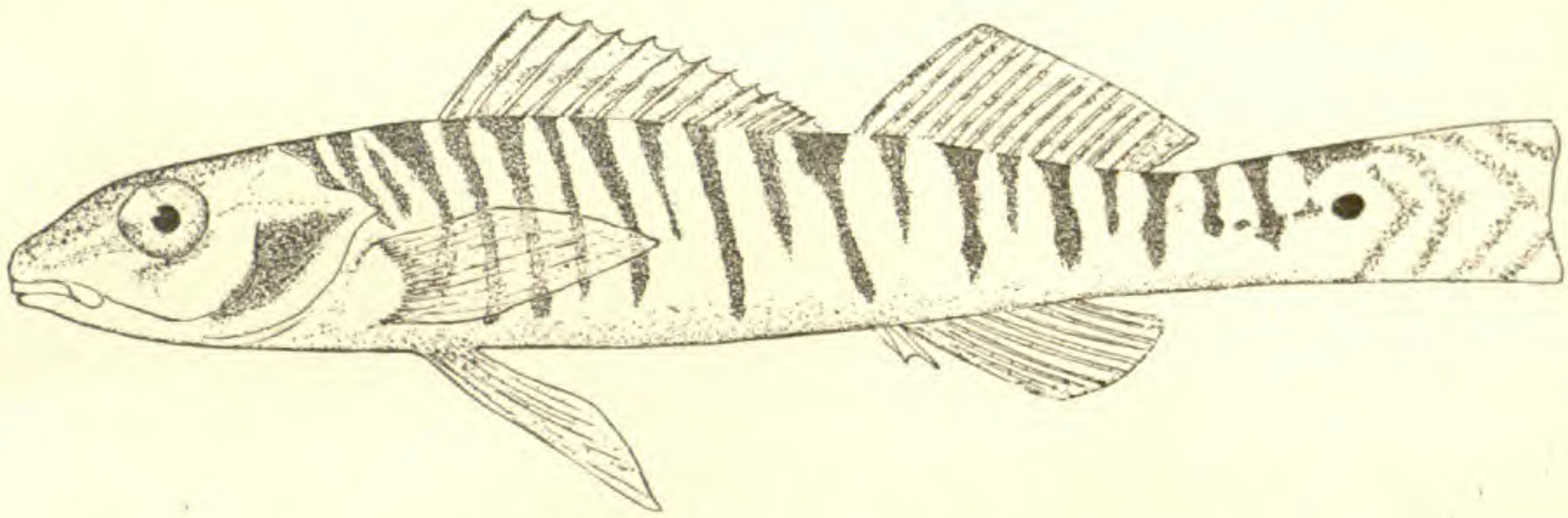


FIG. 2.

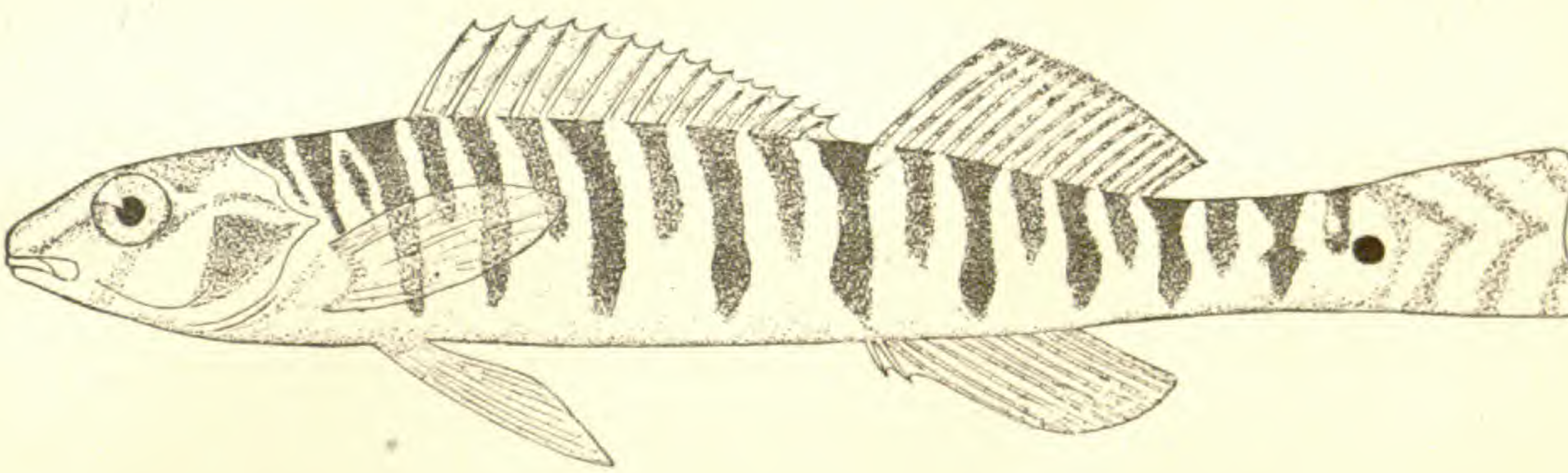


FIG. 3.

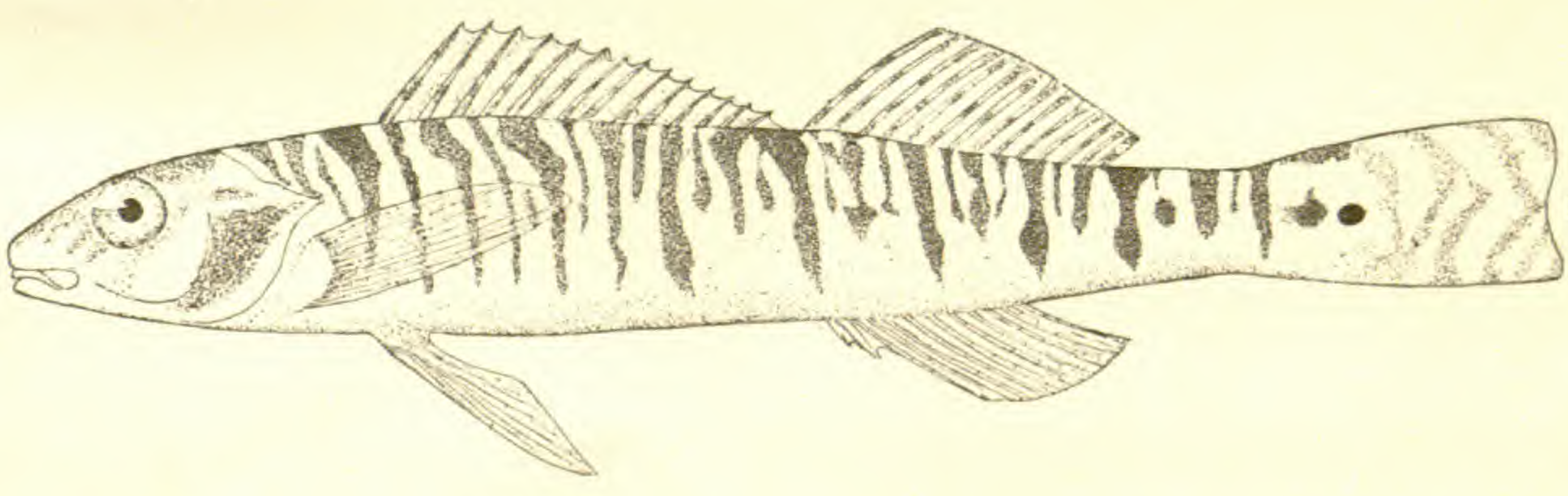


FIG. 4.

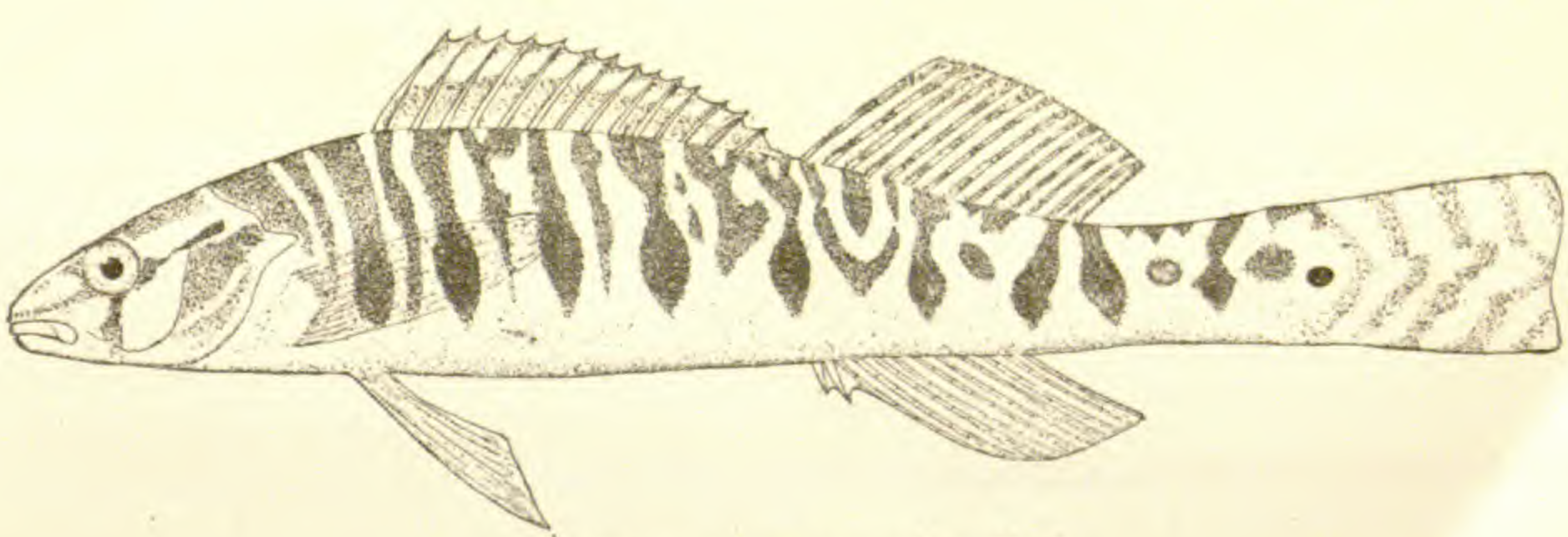


FIG. 5.

Etheostoma caprodes, Raf.

PLATE XIX.

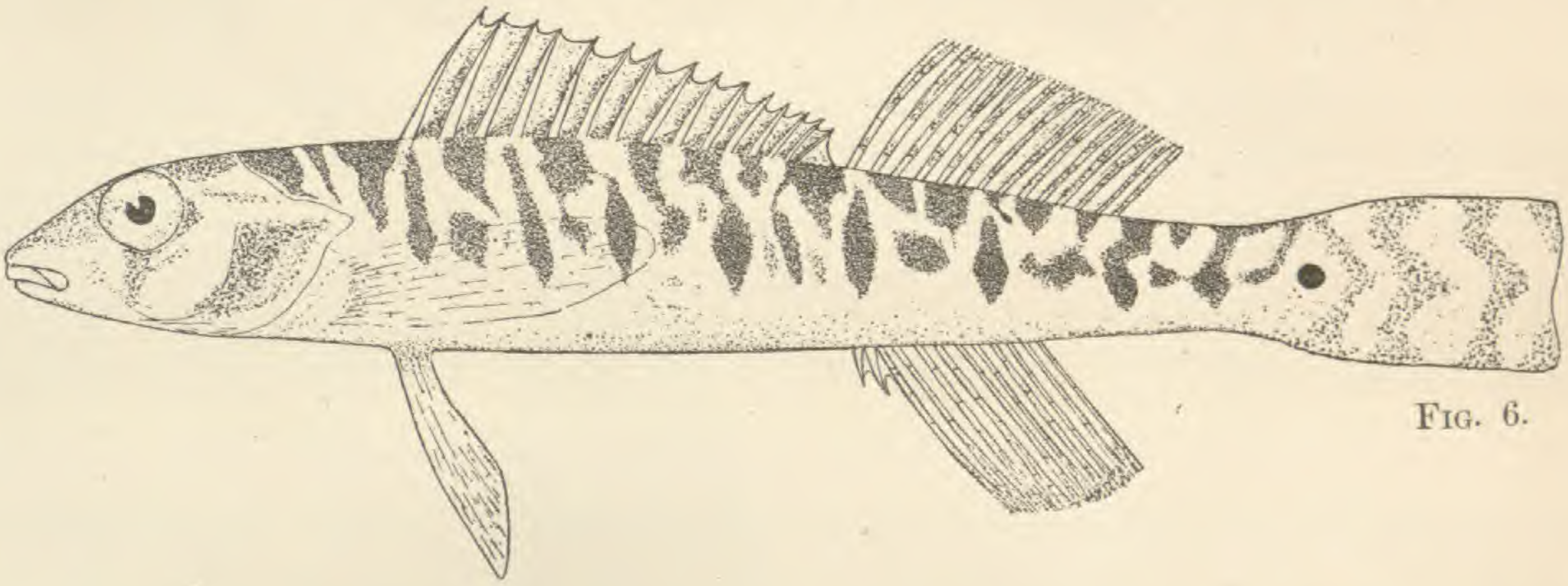


FIG. 6.

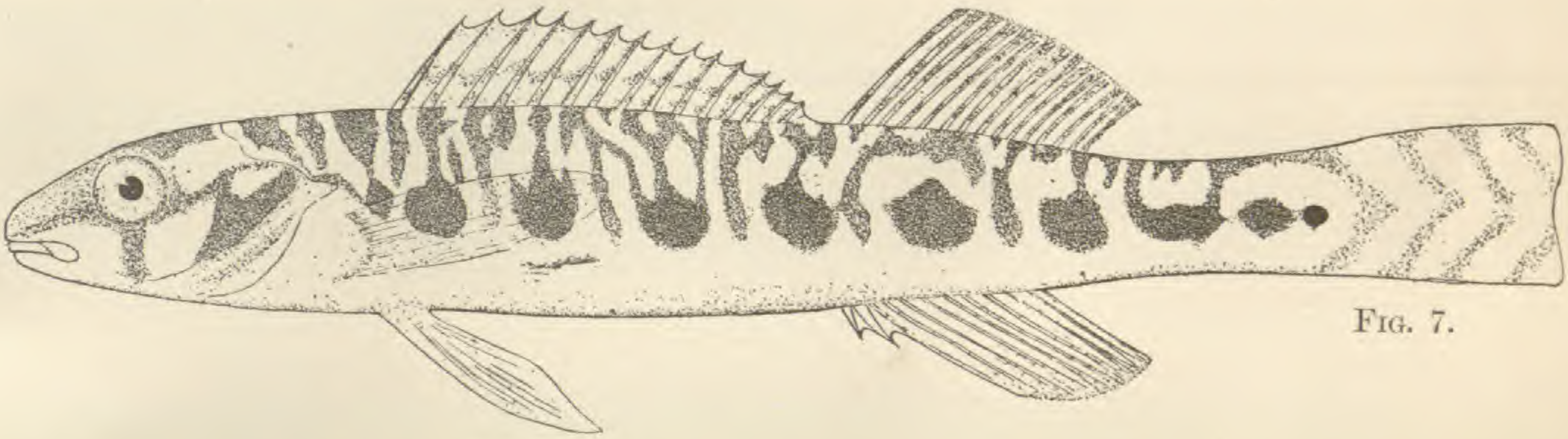


FIG. 7.

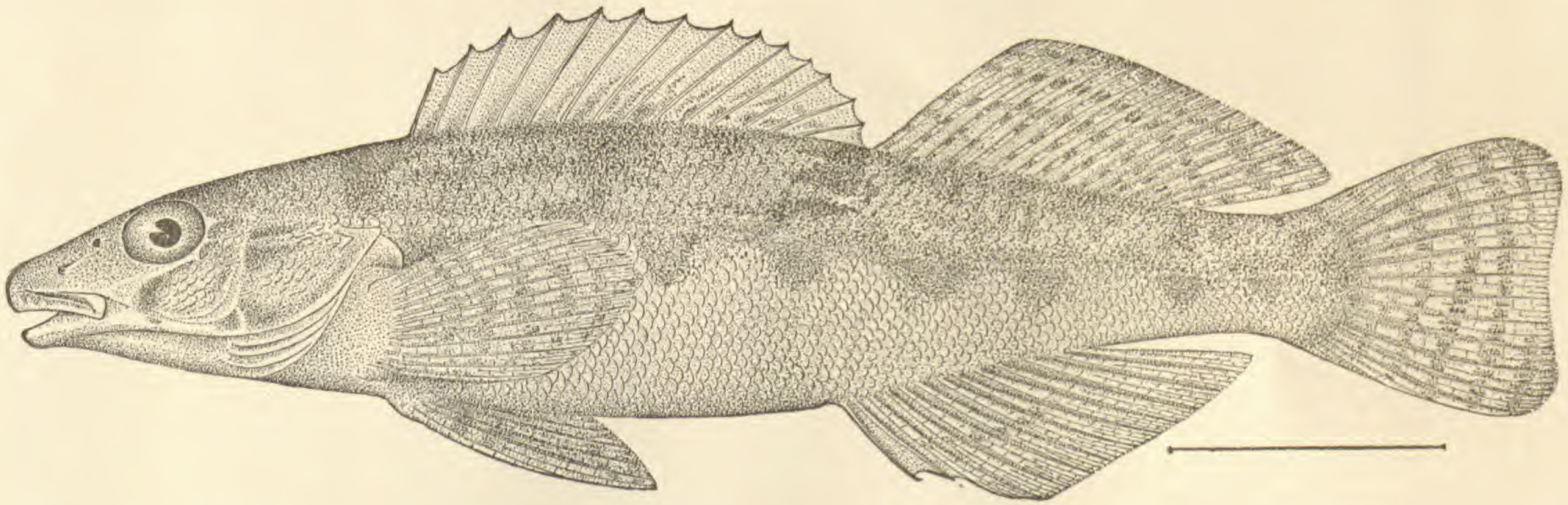
FIG. 8.

FIG. 9.

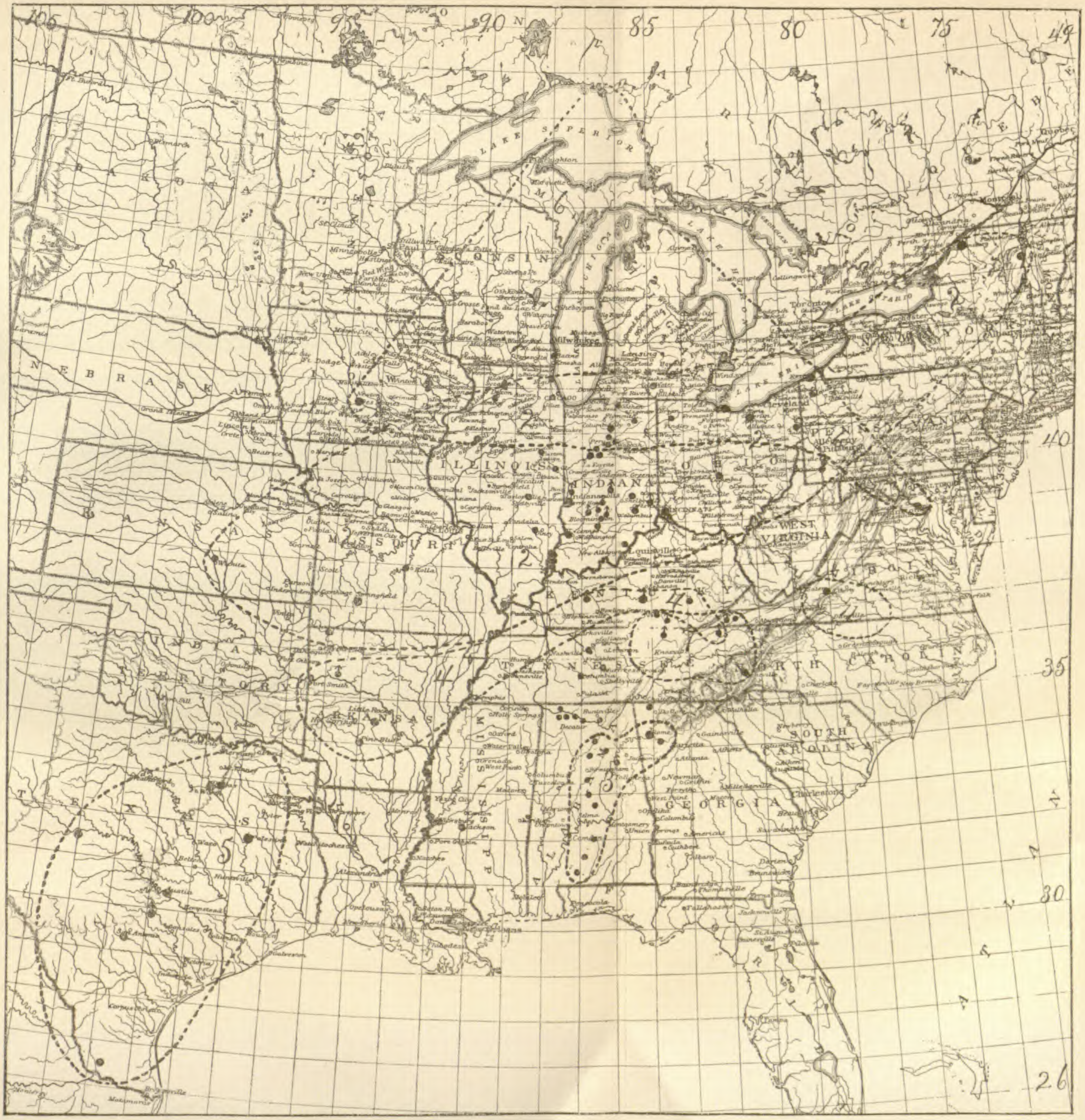
FIG. 10.

Etheostoma caprodes, Raf.

PLATE XX.



Etheostoma rex, Jordan.



Distribution of Etheostoma caprodes.

TABLE V.

Anal Fins.	Number of specimens.	Per cent. of specimens.
II, 10	30	39.47
II, 11	36	47.37
II, 12	10	13.15
Average number of anal rays		$10\frac{14}{19}$

In Table VI are given the variations in the number of scales in the lateral line. The scales were counted on 79 specimens. Eighty-five was the number fonnd in a number having the lateral line incompletely developed. Eighty-five, eighty-eight, eighty-nine and ninety were found in about 60 per cent. of the specimens examined.

TABLE VI.

Scales with Pores.	Per cent. of specimens.	Number of specimens.
76	1	1.265
78	1	1.265
83	1	1.265
85	12	15.20
86	7	8.86
87	7	8.86
88	8	10.12
89	12	15.20
90	18	22.77
91	3	3.80
92	7	8.86
93	2	2.53
Average number of scales		$88\frac{11}{79}$

Table VII indicates the number of specimens, the average number of dorsal spines, and the number of specimens with thirteen, fourteen, fifteen, sixteen and seventeen spines from each of the localities from which specimens were examined. The localities are arranged as they occur, from north to south. It will be seen that the prevailing numbers occurring in the more northern streams are fourteen and fifteen. As we go farther south the usual number is fifteen and sixteen, and in the most southern streams the numbers are fifteen, sixteen and seventeen spines, the specimens from Texas are peculiarly poor in the number of spines.

TABLE VII.

LOCALITY.	Number of specimens.	Average number of dorsal spines.	Number of specimens with 13.	Number of specimens with 14.	Number of specimens with 15.	Number of specimens with 16.	Number of specimens with 17.
Torch Lake, Mich	7	$14\frac{4}{7}$		3	4		
Cedar Rapids, Ia	1	14		1			
White River, at Indianapolis	1	14		1			
Gosport, Ind	5	$14\frac{4}{5}$		1	4		
Bean Blossom, Ind	17	$14\frac{6}{17}$	1	9	7		
Rushville, Ind	1	14		1			
Wild Cat Creek, Ind	1	15			1		
Pike Creek, Ind	2	$14\frac{1}{2}$		1	1		
Illinois	1	15			1		
Nipisink Lake, Ill	2	$14\frac{1}{2}$		1	1		
Monongahela River	1	15			1		
Hartford, Ky	4	15		1	2	1	
Green River, Greensburg, Ky	3	15			3		
Little Barren River, Osceola, Ky	4	15		1	2	1	
Little South Fork Cumberland River, Wayne Co., Ky	1	16				1	
Eagle Creek, Olympus, Tenn	2	$16\frac{1}{2}$				1	1
Obeys River, Elizabethtown, Tenn	13	$16\frac{6}{13}$			2	3	8
Watauga River, " "	2	$15\frac{1}{2}$			1	1	
North Fork Holsten River, Saltville, Va.	1	16				1	
Eureka Springs, Ark	1	16				1	
Chocola Creek, Oxford, Ala	4	$15\frac{1}{2}$			2	2	
San Marcos Springs, Tex	2	$13\frac{1}{2}$	1	1			

Table VIII contains the same data with regard to the dorsal rays. In the last column is given the average number of dorsal spines and rays combined. The rays do not show the same variation found in the dorsal spines, the number being the same for localities north and south. The average number of dorsal spines and rays combined consequently increases with the dorsal spines.

TABLE VIII.

Locality.	Number of specimens.	Average number of dorsal rays.	Number of specimens with 13.	Number of specimens with 14.	Number of specimens with 15.	Number of specimens with 16.	Number of specimens with 17.	Av. num. of dorsal rays & spines.
Torch Lake	7	15		1	5	1		$29\frac{4}{7}$
Cedar Rapids, Ia	1	15			1			29
White River, at Indianapolis	1	16				1		30
Gosport, Ind	5	15			5			$29\frac{4}{5}$
Bean Blossom, Ind	17	$15\frac{16}{17}$			2	14	1	$30\frac{5}{17}$
Rushville, Ind	1	15			1			29
Wild Cat Creek, Ind	1	16				1		31
Pike Creek, Ind	2	16				2		$30\frac{1}{2}$
Illinois	1	14		1				29
Nipisink Lake, Ill	2	15			2			$29\frac{1}{2}$
Monongahela River	1	15			1			30
Hartford, Ky	4	$15\frac{1}{4}$		1	1	2		$30\frac{1}{4}$
Green River, Greensburg, Ky	3	$15\frac{1}{3}$			2	1		$30\frac{1}{3}$
Little Barren River, Osceola, Ky	4	15		1	2	1		30
Little South Fork Cumberland River, Wayne Co., Ky	1	15			1			31
Eagle Creek, Olympus, Tenn	2	$14\frac{1}{2}$		1	1			31
Obeys River, Elizabethtown, Tenn	13	$14\frac{12}{13}$		3	9		1	$31\frac{5}{13}$
Watauga River, " "	2	16				2		$31\frac{1}{2}$
North Fork Holston River, Saltville, Va	1	15			1			31
Eureka Springs, Ark	1	15			1			31
Chocola Creek, Oxford, Ala	4	16			2		2	$31\frac{1}{2}$
San Marcos Spring, Tex	2	15			2			$28\frac{1}{2}$

Table IX gives similar data on the anal fins. The spines are not given since they were found to be two in all cases examined. In the anal rays we have, as in the dorsal spines, a slight increase in their number from north to south. The most common number in the Indiana streams is ten, the number increasing to eleven and twelve in the most southern specimens.

TABLE IX.

LOCALITY.	Number of specimens.	Average number of anal rays.	Number of specimens with 10 rays	Number of specimens with 11 rays	Number of specimens with 12 rays
Torch Lake	7	$10\frac{1}{7}$	6	1	
Cedar Rapids, Ia	1	12			1
White River, at Indianapolis	1	10	1		
Gosport, Ind	5	10	5		
Bean Blossom, Ind	17	$10\frac{9}{17}$	8	9	
Rushville, Ind	1	10	1		
Wild Cat Creek, Ind	1	11		1	
Pike Creek, Ind	2	11		2	
Illinois	1	10	1		
Nipisink Lake, Ill	2	$10\frac{1}{2}$	1	1	
Monongahela River	1	10	1		
Hartford, Ky	4	$10\frac{1}{4}$	3	1	
Green River, Greensburg, Ky	3	$10\frac{2}{3}$	1	2	
Little Barren River, Osceola, Ky	4	11		4	
Little South Fork Cumberland R., Wayne Co., Ky	1	11		1	
Eagle Creek, Olympus, Tenn	2	11		2	
Obeys River, Elizabethtown, Tenn	13	$11\frac{6}{13}$	1	5	7
Watauga River, " "	2	$10\frac{1}{2}$	1	1	
North Fork Holston River, Saltville, Va	1	12			1
Eureka Springs, Ark	1				
Chocola Creek, Oxford, Ala	4	$11\frac{1}{4}$		3	1
San Marcos Springs, Tex	2	11		2	

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Pileoma carbonaria Baird & Girard, "Proc. Acad. Nat. Sci., Phila.," 1853, 387; Girard, U. S. and Mex. Bound. Surv., 10, 1859, pl. VIII, fig. 10–13. Rio Salado, Rio Medina, San Pedro Cr., Tex.); Günther, I, 76, 1859. (Rio Salado, Tex.)

Percina carbonaria Girard, "Proc. Acad. Nat. Sci., Phila., 1859, 67;" Jordan, Proc. Acad. Nat. Sci., Phila., 1877, 54. (Alabama R.); Jordan, Bull. U. S. Nat. Mus. No. 10, 1878, 15. (Texas); Jordan, Ann. N. Y. Lyc. Nat. Hist., 1878, XI, 312. (Alabama R.); Jordan, Bull. U. S. Geo. Surv., 1879, 438. (Texas).

Percina caprodes carbonaria Cope, Bull. 17, U. S. Nat. Mus., 1880, 31. (Trinity R., near Dallas, and Llano R., Kimble Co., Tex.)

Percina bimaculata Haldeman, "Proc. Bost. Soc. Nat. Hist., 1843, 157."

Etheostoma bimaculata Storer, "Synop. Fish N. A., 270–272, 1847."

Pileoma zebra Agassiz, Lake Superior, 308, pl. 4, fig. 4, 1850. (Lake Superior.)

Percina zebra Girard, Proc. Acad. Nat. Sci., Phila., 1859, 66. (Lake Superior); Jordan Bull. U. S. Nat. Mus. No. 10, 1877, 15. (Gr. Lake Region.)

Asproperca zebra Heckel.

Percina caprodes zebra Jordan, Ann. Rept. Com. Fish and Fisheries, 1884, 79.

Percina manitou Jordan, Proc. Acad. Nat. Sci., Phila., 1877, 53. (Lake Manitou in N. Indiana); Jordan, Bull. U. S. Nat. Mus. No. 10, 1877, 15. (Indiana to Minnesota); Jordan, Bull. 2 Ills. State Lab. Nat. Hist., 1878, 3. (L. Manitou, Ind., Wis.); Jordan, Bull. U. S. Geo. Surv., 1879, 438. (Indiana to Minnesota); Jordan, Geo. Surv. of Ohio, IV, 1878, 971. (Lakes of N. Ind., Mich. and Wis.)

Percina caprodes manitou Jordan & Gilbert, Syn. Fish. N. Am., 500, 1883. (Potomac R., Ills., Wis.); Jordan, Man. Vert., 1890, 126. (E. and N. U. S.)

To illustrate the distribution, the localities contained in the works quoted in the bibliography have been marked in the accompanying map.

The localities from which I examined specimens have been marked ♂. The areas inhabited by the various color patterns, as determined by my specimens, and by reports containing sufficiently minute descriptions, are indicated on the map by broken lines. The patterns distributed in each area is indicated by the number of the figure in the plates representing the pattern. In some cases it could not be determined which pattern occurred at the locality. There are some localities on the map, therefore, that are not included in any of the marked areas.

In conclusion, it may be observed:

1. The variation between specimens of the same locality is very slight.

2. The most complicated color pattern can be connected with the simplest by a series of intermediate stages.

3. The variation in color pattern cannot be connected with the latitude inhabited by the different varieties. The color variation is determined, but not in a direct line north and south.

4. The simplest color pattern of the body, found only in immature specimens, consists of nine transverse bars.

5. The simplest color pattern of adults consists of the nine bars seen in the young plus half bars between each two of the primary bars.

6. The next complication arises by the addition of quarter bars. These bars are first introduced in the region between the two dorsals, from which region variation seems to radiate.

7. Another complication may be the splitting of the bars into reticulations on the back and their intensification into larger spots along the sides.

8. Another modification is brought about by the shifting of the the lower half of the whole bars backward, which thus become separated from the dorsal halves. In this, the northernmost variety, the nape is naked.

9. In the simplest pattern, the two sides are usually symmetrical. If unsymmetrical, the asymmetry is introduced in the region of the spinous dorsal fin by a shifting forward or backward of the bars of one side in this region.

10. In the more complicated patterns the asymmetry has become the rule, and has spread along the region of both dorsals.

11. The variation in the combination of dorsal spines and rays is promiscuous.

12. The variation in the number of dorsal rays is promiscuous.

13. The variation in the number of dorsal spines is determinate. The southern specimens having a larger number of spines. Exception: the specimens from San Marcos Spring, Texas.

14. The variation in the number of anal rays is also determinate. As in the case of the dorsal spines, the number varies with the latitude, the southern specimens having a slightly larger number of rays.

Explanation of Plates.

Fig. 1. *Etheostoma caprodes Rafinesque,* 33 mm., Chocola Cr. Oxford, Ala.

Fig. 2. *Etheostoma caprodes Rafinesque,* 83 mm., Bean Blossom, Ind.

Fig. 3. *Etheostoma caprodes Rafinesque,* 88 mm., Chocola Cr., Oxford, Ala.

Fig. 4. *Etheostoma caprodes Rafinesque,* 102 mm., Green R., Greensburg, Ky.

Fig. 5. *Etheostoma caprodes Rafinesque,* 115 mm., San Marcos, Spr., Tex.

Fig. 6. *Etheostoma caprodes Rafinesque,* 88 mm., Torch Lake, Mich.

Fig. 7. *Etheostoma caprodes Rafinesque,* 86 mm., Obeys R., Elizabethtown, Tenn.

Fig. 8. *Etheostoma caprodes Rafinesque,* 115 mm., Lit. S. Fork Cumberland R., Wayne Co., Ky.

Fig. 9. *Etheostoma caprodes Rafinesque,* 60 mm., Gosport, Ind.

Fig. 10. *Etheostoma caprodes Rafinesque,* 85 mm., Obeys R., Elizabethtown, Tenn.

Fig. 11. *Etheostoma rex* Jordan.

Explanation of Map.

2. Pattern 2.
3. " 3.
4. " 4.
5. " 5.
6. " 6.
11. *Etheostoma rex* Jordan.

NEO-LAMARCKISM AND NEO-DARWINISM.[1]

By L. H. Bailey.

It is difficult to accept the hypothesis of organic evolution in the abstract. In the first place, there must be some reason for the operation of a law of transformation or development; and this is found in the ever-changing physical or external conditions of existence, which are more or less opposed to established organisms. And it may also be said that the very fact of the increase of organisms through multiplication must impose new conditions of competition upon every succeeding generation. Again, it is necessary to conceive of some means or machinery by which the process of evolution is carried forward. It was long known that all species vary, that is, that no two individuals in nature are exactly alike; yet there was lacking any hypothesis to show either why these varieties appear or how it is that some become permanent and some do not. The first scientific explanation of the process of evolution was that made in 1809 by the now famous Lamarck. He saw two factors which, he thought, were concerned in the transformation of species—the habitat and the habit. The habitat is the condition in which the organism lives, the environment. This environment, subject to change with every new individual, calls for new habits to adapt the organism to the new needs—inducing greater exercise of some powers or organs and less exercise of others. This greater or less use gradually strengthens or enfeebles the organ concerned, and the modifications thus acquired are preserved "through heredity to the new individuals that are produced by them, provided the changes are common to the two sexes, or to those that have produced these new individuals." There are three things to be considered in this hypothesis: 1. Changes in environment or the conditions of life react upon organisms in the direction of their needs or functions. 2. Organs or powers thus affected are modified to satisfy the new demands. 3. The modifications

[1] Extract from an address before the Philosophical Club of Cornell University.

acquired by the individual are hereditary. This, then, is Lamarckism—that the controlling factor or process in evolution is functional, and that acquired characters are readily transmissible. It is important that I still repeat Lamarck's belief in the transmission of a character obtained by any individual during its own lifetime, for this is the starting point of the definition of an "acquired character" concerning the hereditability of which the scientific world is now rent. "All that nature has caused individuals to acquire or lose through the influence of the circumstances to which their race has been for a long time exposed," says Lamarck, "it preserves," etc. And again, "Every change acquired in an organ by a habitual exercise sufficient to have brought it about, is preserved thereafter through heredity," etc. We shall presently observe how far this definition of an acquired character has been maintained by recent philosophers.

Just fifty years after the publication of Lamarck's theory, Darwin proposed a hypothesis which has had a greater influence upon the habit of scientific thought than any enunciation since the promulgation of inductive philosophy. Darwin, like Lamarck, saw that all forms of life vary; and like him, too, he perceived that there must be a fierce struggle for place or existence amongst the individuals of the rapidly succeeding generations. This variation and struggle are particularly apparent in cultivated plants; and Darwin saw that the gardener selects the best, and thereby "improves" the breed. "Can it, then, be thought improbable," says Darwin, "seeing that variations useful to man have undoubtedly occurred, that other variations useful in some way to each being in the great and complex battle of life, should occur in the course of many successive generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind?" "This preservation of favorable individual differences and variations, and the destruction of those which are injurious, I have called Natural Selection, or the Survival of the Fittest." This, then, is Darwinism—that the controlling factor or process in evolution is selective: the survival, in the struggle for existence, of those individuals which are best fitted to survive. But while this is the naked core of Darwinism, there are various correlative or incidental hypotheses attached to it. Darwin, for instance, accepted in some degree the views of Lamarck as to the importance of functional characters; he considered that sexual selection, or the choice exercised in securing mates, is often an important factor in modifying species; he thought that variation is induced by the modifications of environment, or the "changed conditions of life;" and he was a firm believer in the hereditability of acquired characters. It is around these two great hypotheses—the functional or Lamarckian on the one hand, and the selective or Darwinian upon the other—in various forms and modifications, that the discussions of the philosophy of organic nature are at present revolving.

Before leaving the subject of Darwinism, I wish to touch upon Darwin's view of the cause of variation and his belief in the transmission of acquired characters. We shall presently see that the rehabilitation of the theories of Lamarck, under the name of Neo-Lamarckism, is undertaken, very largely, for the purpose of assigning the origin of variations to external causes, or to the environment, in opposition to those who consider the source of variation to be essentially innate or at least internal. But Darwin also believed that variation is induced by the environment, and the chief factor in this environment, so far as its reaction upon the organism is concerned, is probably excess of food supply, although climate, and other impinging circumstances, are potent causes of modification. He marshalled arguments to support "the view that variations of all kinds and degrees are directly or indirectly caused by the conditions of life to which each being, and more especially its ancestors, have been exposed," and that "each separate variation has its own proper exciting cause." I do not understand how it has come about that various writers declare that Darwin did not believe explicitly in the external cause of variation, and that they feel obliged to go back to Lamarck in order to find a hypothesis for the occasion. It is true that Darwin believed that the nature or direction or particular kind of variation in a given case, is determined very largely by the constitution of the organism, but variation itself, that is, variability, proceeds largely from external causes; and the characters arising in the lifetime of an individual may become hereditary. I must hasten to explain, however, that Darwin clearly recognized the importance of the union of sexes, or crossing, as a cause of variation.

While Darwin believed that the effects of variability arise "generally from changed conditions acting during successive generations," he nevertheless believed that the first increment of change—that arising in the first individual of a given series—might be directly carried over to the first offspring. That is, he believed in the hereditability of acquired or new external characters, a fact which is emphasized by his conviction that certain mutilations, and even the effects of use and disuse, may be transmitted. Yet, whilst Darwin accepted the doctrine, he believed it much less thoroughly than Lamarck did, and it is but an incidental part of his philosophy, while it is an essential tenet of Lamarckism.

Thus far, the heriditability of all important characters had not been disputed. In other words, heredity as a general law or force in the organic world, had been assumed. But with the refinement of the discussions it became necessary to conceive of some definite means through which the transmission of particular characters or features should operate; and it was soon found, also, that no philosophy of evolution can expect to explain the phenomena of organic life unless it is connected and co-ordinated with some hypothesis of the method of heredity. While, therefore, a hypothesis of heredity need not necessarily be associated with the abstract theory of evolution, all such hypotheses which are now before the scientific world have for their particular object the explanation of the assumed progressive tendency of the forms of life.

It is incomprehensible that the minute fertilized ovum or ovule should reconstruct the essential characters of the two individuals from which it proceeds, unless it has in some way derived distinct impressions from every part and organ of the parental bodies which it reproduces. It would seem as if it must of itself be an epitome or condensation of its parents, with the power of unfolding its impressions or attributes during the whole life course of the organism to which it gives rise. Several hypotheses have been announced to account for the phenomena of heredity, of which, one of the most important is still Darwin's theory of pangenesis. Darwin supposed, provisionally, that besides the ordinary multiplication of the cell, each cell may "throw off minute granules which are dispersed throughout the whole system; that these, when supplied with proper nutriment, multiply by self-division, and are ultimately developed into units like those from which they were originally derived." These granules, or gemmules, have a natural affinity for each other, and they collect themselves "from all parts of the system" to form the sexual materials or elements. These sexual elements, therefore, which unite to form the new individual, are an epitomized compound of the parents. The value of this hypothesis, it seems to me, lies not so much in the particular constitution and behavior of these gemmules, as in the fact that it attempts to account for the known phenomena of life by supposing each corporeal element to be represented in the sexual elements. The hypothesis has never gained wide support, because of the supposed physical improbability of the gemmules and of their concentration in sexual system; yet it should be said that a simpler one, which can account for the facts, has not yet been advanced, unless it be the bathmic hypothesis of Cope, which supposes that each body-cell transmits "a mode of motion" to the germ-cell.

For the present purpose, we need consider but one other hypothesis of heredity—that advanced in 1883 by Weismann, which has given rise to the philosophy now called Neo-Darwinism. Weismann's point of view is interesting and unique. He places himself at the threshold of organic life and contemplates what takes place in the reproduction of one-celled organisms. These organisms multiply largely by simple division, or fission. When the organism reaches a certain size, it becomes constricted near its middle, and finally parts into two cells or organisms. It is evident that one organism is twin of the other, neither is older, neither is parent, but each has partaken of the common stock of protoplasm. The protoplasm again multiplies itself in the two organisms, and at length it is again divided; and so, to the end of time, the remotest individual of the series may be said to contain a portion of the original protoplasm; in other words, the protoplasm is continuous. And inasmuch as protoplasm is the seat or physical basis of life, it may be said that the one-celled organism is immortal, or is not confronted by natural death.

In time, however, there came a division of labor—cells living together in colonies, and certain cells performing one function and certain other cells other functions. This was, perhaps, the beginning of the many-celled organism, in which certain cells developed the specific function of reproduction, or eventually became elements of sex. As organisms became more complex in their structure, there came to be great differences between this reproductive or germ portion and the surrounding or body portion; and Weismann assumes that these two elements are different and distinct from each other in kind, and that inasmuch as the one-celled organisms propagated their exact kind by simple division, that therefore the reproductive elements of the many-celled or complex body must continue to perpetuate their kind or enjoy immortality, while all the surrounding or body cells die and are reproduced only through the reconstructive power of the sexual elements. There are, then, according to this hypothesis, two elements or plasms in every organized being, the germ-plasm and the soma-plasm or body-plasm; and every organism which procreates thereby preserves its germ-plasm to future generations, while death destroys the remainder. A vital point in this hypothesis is the method by which the soma-plasm, or the organs and body of the organism, can be so impressed upon the germ that they shall become hereditary. At first it would seem as if some assumption like that of Darwin's might be useful here—that this germ-plasm is impressed by particles thrown off from all the surrounding or soma-cells; but this Weismann considers to be too unwieldy, and he ascribes the transfer of these characters through the medium of the germ-plasm to "variations in its molecular constitution." In other words, there can be no heredity of a character which originates at the periphery of the individual, because there is no means of transferring its likeness to the germ. All modification of the offspring is predetermined in the germ-plasm; and if the new organism becomes modified through contact with external agencies, such modification is lost with the death of the individual. "Characters only acquired by the operation of external circumstances acting during the life of the individual, cannot be transmitted." "All the characters exhibited by the offspring are due to primary changes in the germ." It is admitted that the continued effect of impinging environment may, now and then, finally reach the germ-plasm, but not in the first generation in which such extraneous influence may be exercised. In other words, acquired characters cannot be hereditary.

It would seem as if this hypothesis precluded the possibility of evolution or the continued modification of species, inasmuch as it does not accept the modifications arising directly from external sources. But Weismann supposes that variation originates—or at least all variation which is of permanent use to the species—from a union of the sexes, inasmuch as the unlike germ-plasms of two individuals unite; and from the variations thus induced are derived the materials upon which natural selection works in the struggle for existence. "I am entirely convinced," Weismann writes, "that the higher development of the organic world was only rendered possible by the introduction of sexual reproduction." "Sexual reproduction has arisen by and for natural selection, as the only means by which the individual variations can be united and combined in every possible proportion."

It will be seen that Weismann is a Darwinian—a believer in natural selection as the one controlling process of evolution; but, unlike Darwin, he refers variation to sex and declares that any new or acquired character originating in the body of the organism cannot be transmitted. The exact means or machinery through which he supposes heredity to act, is rather more an embryological matter than a philosophical one. We are particularly concerned in its results, which are the distinguishing marks of Neo-Darwinism—that variation is of sexual or internal origin, and that acquired characters are not hereditary.

In opposition to this body of belief, which has been upheld, particularly in England, with much aggressiveness, is Neo-Lamarckism, which is a compound of both Lamarckism and Darwinism, and which has an especially strong following in North America. The particular canons of this philosophy are the belief that external causes, or the environment, are directly responsible for much variation and that acquired characters are often hereditary. Other features of it, held in varying degrees by different persons, are the belief in the transforming effects of use and disuse, and in natural selection.

The one great schism between the Neo-Darwinians and the Neo-Lamarckians is the controversy over the hereditability of acquired characters, and just at present this question has come so strongly to the fore that other differences in the two hypotheses have been obscured. It is worthy of remark that Darwinism or Neo-Lamarckism sees first the facts or phenomena and then tries to explain them; while Neo-Darwinism or Weismannism assumes first a hypothesis and then tries to prove it. I think that any one will be struck with this difference of attitude, if he read Darwin's chapter upon pangenesis, and then read Weismann's essay upon heredity. The Neo-Darwinians are loud in demand of facts or proof that acquired characters are hereditary, and they attempt to throw the burden of proof upon their opponents; while, at the same time, they give no proofs of their own position, and confound their adversaries with verbal subtleties. The burden of proof, however, lies clearly upon the Neo-Darwinians, inasmuch as they have assumed to deny phenomena which were theretofore considered to be established.

A voluminous issue of polemics has occurred during the last five or six years between the Neo-Darwinians and the Neo-Lamarckians; but whatever may have been its effects upon the older philosophy, it is clear, to my mind, that some of the attacks upon Neo-Darwinism are unanswerable in any rational manner, and it is certain that they have forced Weismann into a change of position with reference to some of his definitions. Certain phases of this discussion appeal with particular force, of course, to some minds, while they exert little influence upon others. My own objections to Neo-Darwinism—and I admit that my bias is strong against it—seem to be somewhat different from those most commonly urged in opposition to it; and the three which chiefly influence me I shall present very briefly.

1. I cannot see that the non-transmissibility of acquired characters is a necessary assumption to Weismann's fundamental arguments. I have already explained his reasoning from the reproduction of the one-celled organism. I cannot attempt any opinion of the probable facts upon which the hypothesis is founded. It may be said, in passing, that one of the prominent objections to the fundamental basis of the theory is the difficulty of deriving the mortal soma-plasm from the immortal germ-plasm, a question to which, however, Weismann has made a somewhat full reply.

When organisms became complex, it was necessary to assume either that the soma-plasm does or does not directly influence the germ-plasm. Weismann discarded the various hypotheses which suppose that there is a vital and necessary connection between the body units and reproductive units, and then to avoid the difficulties which the hereditability of acquired characters would entail, he supposed that such characters are not hereditary. His subsequent labors have been largely employed in trying to show that they are not. This supposition was made for the purpose of simplifying the hypothesis by removing the cumbrous gemmules of Darwin and the similar bodies or movements of other philosophers, and therefore by localizing the seat of the germ-plasm. But he immediately encounters difficulties quite as great as those which he avoids. In cases where there are alternate generations of asexual and sexual organisms, he must suppose that the germ-plasm is united with the soma-plasm, and is probably, therefore, distributed throughout the body. "There may be in fact cases," Weismann writes, "in which such separation [of the germ-plasm from the soma-plasm] does not take place until after the animal is completely formed, and others, as I believe that I have shown, in which it first arises one or two generations later, viz., in the buds produced by the parent." And he has been compelled to admit that in the case of begonias, which are propagated by leaves, the germ-plasm is probably distributed throughout the foliage; and he must make a similar admission for all plants, for they can all be propagated and modified through asexual parts. This is admitting, then, that there is no localized germ-plasm in the vegetable kingdom and in some instances in the animal kingdom; and if the germ-plasm is distributed to the very periphery of the organism, why may it not be directly affected by environment, the same as the soma-plasm is? Or why is the hypothesis any the less objectionable than Darwin's pangenesis, which supposes that every organic unit can communicate with the germ?

Weismann also supposes, as I have said, that the means by which the germ-plasm is able to reconstruct the soma-plasm in the offspring, is through some modification in its "molecular constitution," an assumption which was by no means novel when Weismann announced it. "The exact manner in which we imagine the subsequent differentiation of the colony to be potentially present in the reproductive cell," he writes, "becomes a matter of comparatively small importance. It may consist in a different molecular arrangement, or in some change of chemical constitution, or it may be due to both these causes combined." In whatever manner the germ-plasm receives its somatic influences, there must be a direct connection between the two, and it is quite as easy to assume the existence of gemmules as any less tangible influence. I am not arguing in favor of pangenesis, but only stating what seems to me to be a valid objection to the fundamental constitution of the Weismannian hypothesis—that it is quite as easy to assume, from the argument, one interpretation of the process or means of heredity as another. And if there is any vital connection whatever between the soma-plasm and the germ-plasm—as the hypothesis itself must admit—then why cannot the soma-plasm directly influence the germ-plasm?

Again, I wish to point out that modification and evolution of vegetable species may and does proceed wholly without the interposition of sex—that is, by propagations through cuttings or layers of various parts. This proves either one of two things—that the germ-plasm is not necessary to the species, or else that it is not localized but distributed throughout the entire body of the individual, as I have shown above; and either horn of this dilemma is fatal, it seems to me, to Weismannism. If the germ-plasm is not necessary to this reproduction, then we must discard the hypothesis of the continuity of the germ-plasm; if the germ-plasm is distributed throughout the plant, then we are obliged to admit that it is not localized in germ-cells beyond the reach of direct external influences.

This sexual propagation of plants has been brought to Weismann's attention by Strasburger, who cited the instance of the leaf-propagation of begonia, and said that plants thus asexually multiplied afterwards produce flowers and seeds, or develop germ-plasm. Weismann meets the objection by supposing that it is possible for "all somatic nuclei to contain a minute fraction of unchanged germ-plasm," but he considers the begonia, apparently, to be an exception to most other plants, inasmuch as he declares that "no one has ever grown a tree from the leaf of the lime or oak, or a flowering plant from the leaf of the tulip or convolvulus." Henslow meets this latter statement by saying that this has not been accomplished simply because "it has never been worth while to do it. If, however, a premium were offered for tulips or oak-trees raised from leaf-cuttings, plenty would soon be forthcoming." What Weismann wishes to show is that the begonia is an exception to other plants in allowing of propagation from leaf-cuttings, although he should have known that hundreds of plants can be multiplied in this way, and that—what amounts to the same thing—all plants can be propagated by asexual parts, as stems or roots.

But there is another aspect to this asexual multiplication of plants which I do not remember to have seen stated in this connection. It has been said that the asexually multiplied plants may afterwards produce flowers and resume the normal method of reproduction and variation. I now wish to add-what I have already said, that plants may be continuously multiplied asexually and yet the offspring may vary, and the variations may be transmitted from generation to generation, quite as perfectly as if seed production intervened. This has been true with certain plants through a long period of time, as the banana, and every intelligent gardener knows that plants propagated by cuttings often "sport" or vary. Here are cases, then, in which variation does not originate from sex, unless Weismann is willing to concede that the result of previous sexual union has remained latent through any number of generations and has been carried to all parts of the plant by a generally diffused germ-plasm; and if this is admitted, then I must again insist that this germ-plasm must be just as amenable to external influences as the soma-plasm with which it is indissolubly associated. I have repeated this argument in order to introduce the subject of "bud variations," or those "sports" which now and then appear upon certain limbs or parts of plants and which are nearly always readily propagated by cuttings. These variations cannot be attributed to sex, in the ordinary and legitimate application of the Weismannian hypothesis. Whilst these "sports" are well known to horticulturists, they are generally considered to be rare, but nothing can be farther from the truth. As a matter of fact, every branch of a tree is different from every other branch, and when the difference is sufficient to attract attention, or to have commercial value, it is propagated and called a "sport." This leads me to recall the old discussion of the phytomer, or the hypothesis that every node and internode of a tree—and we might add the roots—is in reality a distinct individual, inasmuch as it possesses the power of leading an independent existence when severed from the plant, and of reproducing its kind. However this may be as a matter of of speculation, it is certainly true as regards the phenomenon, and shows conclusively that if the germ-plasm exists at all, it exists throughout the entire structure of the plant.

This conclusion is also unavoidable from another consideration—the fact that plants are asexual organisms at all times previous to flowering, and the germ-plasm must be preserved, in the meantime, along with the soma-plasm. But this conclusion is inconsistent with Weismannism as taught at present, and this alone would lead me to discard the hypothesis for plants, however well it may apply to the animal kingdom.

Henslow has made a different argument to show that the germ-plasm of plants may be directly exposed to external influence (*Origin of Floral Structures*). The germ-plasm is assumably located in the flower, and the egg-cell of the embryo-sac and the sperm-cell of the pollen grain are close to the surface, and are directly impressed by the interference of bees and other external stimuli. Henslow endeavors to show "that the infinite variety of adaptations to insects discoverable in flowers may have resulted through the direct action of the insects themselves, coupled with the responsive power of protoplasm." And these characters must be in part acquired during the lifetime of a given individual.

2. It seems to me, also, that the presumption, upon general philosophical grounds, is against the doctrine that immediate external influences are without permanent effect. If we admit—as all philosophers now do—that species are mutable, and that the forms of life have been shaped with reference to their adaptations to environment, then we are justified in assuming that every change in that environment must awaken some vital response in the species. If this response does not follow, then environment is without influence upon the organism; or if it follows and is then not transmitted, it is lost just the same, and environment is impotent. And it does not matter if we assume, with the Neo-Darwinians, that this effect does not become hereditary until the germ is affected—that is, until two or more generations have lived under the impinging environment—it must nevertheless follow that the change must have had a definite beginning in the lifetime of an individual; for it is impossible to conceive that a change has its origin in two generations. In other words, the beginning is singular; two generations is plural. And whether the modification is di-

rectly visible in the body of the organism or is an intangible force impressed upon the germ, it is nevertheless an environmental character, and was at first acquired. If this is not true—that the changed conditions of life exert a direct effect upon the phylogeny of the species—then no variation is possible save that which comes from the recompounding of the original or ancestral sex-elements; and it would still be a question how these sex-elements acquired their initial divergence.

The Neo-Darwinians would undoubtedly meet this argument by saying that their hypothesis fully admits the importance of these external influences, the only reservation being that they shall have affected the germ. It is true that this is a common means of escape; but it cannot be gainsaid that the denial of the influence of the external or environmental forces is really the fundamental difference between them and the Darwinians or Neo-Lamarckians, as the following quotation from Weismann will show: "Our object is to decide whether changes in the soma (the body, as opposed to the germ-cells) which have been produced by the direct action of external influences, including use and disuse, can be transmitted; whether they can influence the germ-cells in such a manner that the latter will cause the spontaneous appearance of corresponding changes in the next generation. This is the question which demands an answer; and, as has been shown above, such an answer would decide whether the Lamarckian principles of transformation must be retained or abandoned."

If, then, to repeat, organisms are adapted to their environment, it must be equally true that this environment directly affects its inhabitants; and considering the intense struggle for existence under which all organisms live, it is highly probable that any advantageous variation can be seized upon at once. I cannot conceive that nature allows herself to lose the result of any effort.

3. My third conviction against Neo-Darwinism arises from the fact that its advocates are constantly explaining away the arguments of their opponents by verbal mystifications and ingenious definitions. This charge is so frequently made, and

the fact is so well known, that it seems almost useless to refer to it here; and yet there are some phases of it upon which I cannot forbear to touch.

Weismann declares that he uses the term "acquired character" in its original sense. This term, or at least the idea, was first employed, as we have seen, by Lamarck, who used it or an equivalent phrase to designate "every change acquired in an organ by a habitual exercise sufficient to have brought it about." In fact, the basis of Lamarck's philosophy is the assumption of the hereditability of characters arising directly from use or disuse; and his idea of an acquired character is, therefore, one which appears in the lifetime of the individual from some externally inciting cause. Darwin's notion, while less clearly defined, was essentially the same, and he collected a mass of evidence to show that such characters are transmissible; and he even went farther than Lamarck, and attempted to show that mutilations may be hereditary. Weismann's early definition of acquired characters is plain enough. Such characters, that is, the somatogenic, "not only include the effects of mutilation, but the changes which follow from increased or diminished performance of function, and those which are directly due to nutrition and any of the other external influences which act upon the body." Standing fairly and squarely upon this definition, it is easy enough to disprove it —that is, to show that some characters thus acquired are hereditary. But the moment proofs are advanced, the definition is contracted, and the Neo-Darwinians declare that the given character was potentially present in the germ and was not primarily superinduced by the external conditions—a position which, while it allows of no proof, can neither be overthrown. A cow lost her left horn by suppuration, and two of her calves had rudimentary left horns; but Weismann immediately says, "The loss of a cow's horn may have arisen from a congenital malformation." Certainly! and it may not; and the presumption is that it did not. A soldier loses his left eye by inflammation, and two of his sons have defective left eyes. Now, "the soldier," says Weismann, "did not lose his left eye because it was injured, but because it was predisposed to become diseased from the beginning, and readily became inflamed after a slight injury"! This gratuitous manner of explaining away the recorded instances of the supposed transmission of mutilations and the like, is common with the Neo-Darwinians, but it must always create the impression, it seems to me, of being labored and far-fetched; and inasmuch as it is incapable of proof, and is of no occasion beyond the mere point of upholding an assumed hypothesis, it is scarcely worthy serious attention. It would be far better for the Neo-Darwinians if they would flatly refuse to accept the statements concerning the transmission of mutilations, rather than to attempt any mere captious explanation of them; for it is yet very doubtful if the recorded instances of such transmissions will stand careful investigation.

But perhaps the most remarkable example of this species of Neo-Darwinian logic is produced by Weismann when he is hard pressed by Hoffmann, who supposed that he had proved the hereditability of certain acquired characters in poppies. Weismann says: "Since the characters of which Hoffmann speaks are hereditary, the term cannot be rightly applied to them;" thus showing that his fundamental conception of an acquired character is one which cannot be transmitted! He then proceeds to elaborate this definition as follows: "I have never doubted about the transmission of changes which depend upon an alteration in the germ-plasm of the reproductive cells, for I have always asserted that these changes, and these alone, must be transmitted." Then he proceeds to say that it is necessary to have "two terms which distinguish sharply between the two chief groups of characters—the primary characters which first appear in the body itself, and the secondary ones which owe their appearance to variations in the germ, however such variations may have arisen. We have hitherto been accustomed to call the former 'acquired characters,' but we might also call them 'somatogenic,' because they follow from the reaction of the soma under external influences; while all other characters might be contrasted as 'blastogenic,' because they include all those characters in the body which have arisen from changes in the germ. * * * We maintain that the 'somatogenic' characters cannot be transmitted, or rather, that those who assert that they can be transmitted, must furnish the requisite proofs." That is: changes in the soma-plasm are not transmitted; acquired characters are changes in the soma-plasm; therefore, acquired characters cannot be transmitted! Or, to use Weismann's shorter phrase, "Since the characters * * * are hereditary, the term ['acquired'] cannot be rightly applied to them!" Surely, Neo-Darwinism is impregnable!

Weismannism has unquestionably done much to elucidate some of the most intricate questions of biology, and it has weeded the old hypotheses of much that was ill-considered and false. It has challenged beliefs which have been too easily accepted. Its value to the science of heredity upon its biological side is admitted, and its explanation of the meaning of sex is one of the best of all contributions to the philosophy of organic nature. It has suffered, perhaps, from too ardent champions, and its great weakness lies in its stubborn refusal to accept an important class of phenomena associated with acquired characters, a sufficient explanation of which, it seems to me, could be assumed without great violence to the hypothesis.

Most Neo-Lamarckians accept much of Weismann's teachings. But, while there are comparatively few who believe that mutilations are directly transmissible, there is a general and strong conviction that many truly acquired characters are hereditary, and there seems to be demonstrable evidence of it; and while sex variation is fully accepted, it logically follows, if acquired characters are hereditary, that much variation is due directly to external causes. Perhaps the habit of thought of most Darwinians and Neo-Lamarckians is something as follows:

All forms of life are mutable. Variation affords the material from which progress is derived. Variation is due to sexual union, changed conditions of life, panmixia or the cessation of natural selection, and probably somewhat to direct use and disuse. There is an intense struggle for existence. All forms or variations useful to the species tend to live, and the harmful ones tend to be destroyed through the operation of the simple agent of natural selection. These newly appearing forms tend to become permanent, sometimes immediately; but the longer the transforming environments are present, the greater is the probability, on the whole, that the resulting modifications will persist.

ORNITHOPHILOUS POLLINATION.

BY JOSEPH L. HANCOCK.

The position that some of the humming-birds occupy in respect to the transference of pollen from flower to flower is by no means subordinate to insects.[1]

The common ruby-throated humming-bird (*Trochilus colubris*) though not endowed with specialized structures for the specific performance of this office, bears upon careful study evidence that the mouth parts and feathers have certain means for the harboring of pollen quite beyond the ordinary views. The anatomical peculiarities of this bird's head allows access to flowers, covering a wide range of forms. A narrowing awl-shaped cone 29 mm. long represented by a base of 10 mm. admits of this latitude, as expressed more clearly in the accompanying plate, figures 2 and 3, of the head and skull. By reason of some flexibility, the bill is capable of probing to the bottom of nearly all the forms of flowers commonly met with. In the feeding process, familiar to almost every one, the flower is often bent over to be relieved of its juices. The trumpet honeysuckle (*Lonicera sempervirens*) in the proper season, furnishes an important part of the food of *T. colubris*. This vine appears wild in the south, the corolla of the flower is long, see figure 6, red and scentless. There is a way of accounting for this latter condition. Fragrant odors are largely essential to the attraction of bees and other insects, but as this plant does not lean upon their aid for fertilization, but depends more upon the humming-bird and larger moths for the interchange of pollen, the absence of fragrance is accounted for. The two last mentioned, from my own observations, depend for the most part upon sight for the detection of food plants. A male specimen of the ruby-throated humming-bird which was taken from a cat which had seized it in the act of feeding upon the nectar of flowers, was sent to the writer by a friend. From

[1]To this power in birds the designation of *ornithophilous* pollination is proposed in contradistinction to *entomophilous* pollination.

this and other dead specimens was derived much of the present knowledge. A cursory examination with the naked eye of the head does not reveal with clear distinctness the important facts brought out by the use of the microscope, consequently this instrument was brought into use in furthering research. Pollen is carried in several ways by this bird. On the lower mandible just in front of the angle of the mouth, overshadowed by the nasal scale when the bill is closed, a faint yellowish line marks the deposit of pollen grains resting in a small groove clustered together, see figure 5 at point b. Here were found various kinds, but one small form rather irregularly round in outline predominated. Pollen-grains work their way free to the summit or vanes of the feathers about where they were seen scattered, and as will be described further on, caught up by the barbs of the feathers, along the sides of the chin and lores ready to be deposited when a more suitable surface presents. Under the lower bill, see enlarged view, figure 4, and also 5a, the deep median groove, the point of meeting of the rami, which traverses along for nearly one-half its length, acts as a second repository. This pollen repository groove becomes divided backwards on either side for a short distance. Pollen lodges in larger quantities here and can be detected deep within the median portion of the groove. It is interesting to note that pollen found deep in the recess of this part bore evidence of greater age and possibly from foreign plants unknown to me. This fact opens up a line of investigation which promises interesting results in the future. With a needle the mass of grains which cluster together can be removed and separated with care. A small mass, only a fractional part of what still remained, showed with a focus of a $\frac{1}{4}$ inch objective hundreds of pollen-grains. The long shaft of the bill also had upon its surface a few scattered ones. The most noteworthy phase of this subject remains yet to be recorded when the feathers are analyzed in greater detail, for here is to be found the real means of scattering the pollen or pollination. The chief *repositories* having been just described as occurring below the angle of the mouth and in the median groove under the lower mandible, it remains to mention the part taken by the feathers.

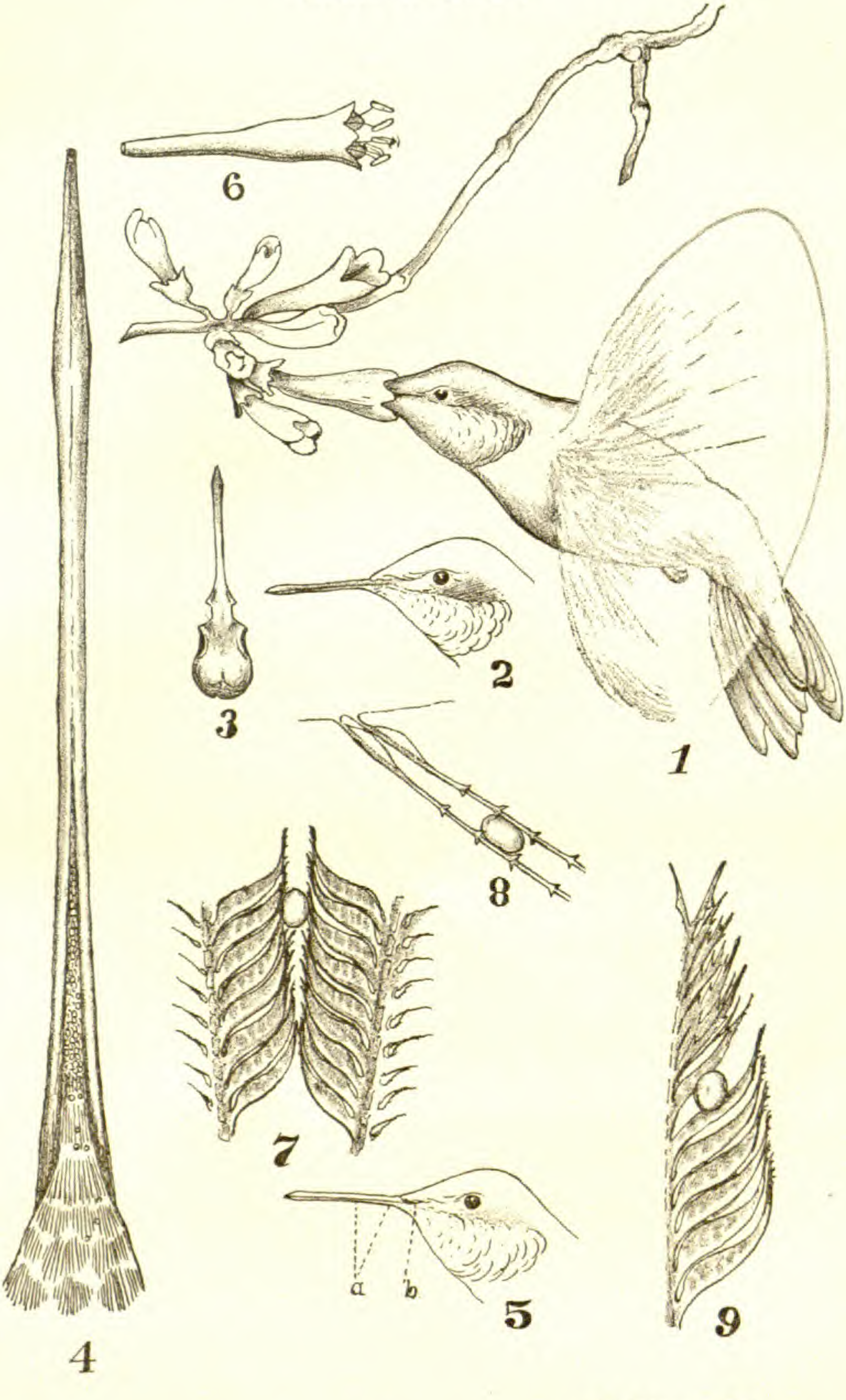
There are four ways by which the pollen becomes engaged or held by the feathers, which will be better understood after the anatomy of the latter structures are touched upon. The feathers from the sides of the head, lores and below, are mainly instrumental in this work. In general they are much like feathers of other birds, of the contour type, plumulaceous at the base, composed of a short, weak calamus, a rhachis, vanes, barbs and barbules; the latter being peculiar in that at the extremity of the vane the barbules are armed with sharp, thistle-like projections (barbicels) some of which are somewhat curved. The vanes at the base of the feathers are long and thread-like, near where they join the shaft are flattened oar fashion as seen in figure 8. Little pointed barbs divide these filimentous vanes at regular short distances. One of the methods of carrying pollen is here met with between two of the vanes as shown. The vanes of the upper part of the main body of the feather, are made up of narrow acute plates or barbs resting close together. The barbs of another vane often encroach or touch the barbs of a neighboring vane, so that between them is found entrapped many pollen-grains as demonstrated in figure 7. Another way by which pollen is effectually engaged is between two of the barbs merely spread apart, giving room for the grain to be held as in figure 9. The fourth method observed of carrying these fertilizing agents is an extraneous one, depending upon the glutinous secretion from the stigma of plants that adhere to the feathers, thus assisting the pollen to stick fast to the feather. Through a high magnifying power is seen the thistle-like ending of the vanes, the barbules frequently matted together by the sticky secretion referred to, gathered from the flowers while in search of food. Attached to the many pointed and flattened surfaces were seen pollen-grains of many kinds, chiefly of very minnte size, ready to depart or taken on anew at the next visit to a flower. In anemophilous flowers in which the wind is the agency for carrying the pollen, the grains are usually small, light, more or less dry and spherical, while in entomophilous flowers, the pollen of which is carried from one plant to another by insects in search of honey, are variously adapted to cause the grains to adhere to the hairy underside of the insects body to promote their dispersion. In ornithophilous pollination the pollen is carried in such diverse ways that this together with other data combine to make it possible that the humming-bird is the most wonderful distributor of pollen known to the animal world. We are not content to leave the subject without noticing, that as compared with insects, the local range of flight of humming-birds is undoubtedly greater and during the regular migrations they make extensive flights.[2] Their summer home in eastern North America extends from the Gulf of Mexico to half way across the British Provinces and from the Atlantic Coast to beyond the Mississippi River. In winter its range is southward, reaching into Southern Florida, into Veragua and the western portion of the Isthmus of Panama, about eight degrees north of the equator. The equivalent of some 2000 statute miles is thus represented in the migrations of this diminutive bird. The pollen taken enroute during migration, as the humming-bird takes its sip of nectar from flower to flower, may gather in its repositories and be transported from place to place anywhere throughout its range. That some strange pollen grains are found entangled upon the bird is not surprising, especially in spring, taking these suggestions into consideration, and what wonder is it we are called upon to say that the phenomena of so widespread and perpetual a means of pollination of plants is perhaps unparalleled.

Explanation of Plate.

Fig. 1. *Trochilus colubris* taking food, drawn from memory.
Fig. 2. Head of *T. colubris* from nature.
Fig. 3. Skin removed from head to show skull.

[2]It will be observed that the author refers entirely to the ruby-throated humming-bird (*T. colubris*) here, and what may be brought out by a further study of other species as regards to the part they play in pollination is a matter for the future.

PLATE XXII.



J. L. Hancock, Del.

Ornithophilous pollination.

Fig. 4. Enlarged ventral view of lower mandible showing pollen repository groove.

Fig. 5. Head of *T. colubris* showing *a*, side repository, *b*, repository under the lower mandible.

Fig. 6. Single flower of Trumpet Honeysuckle.

Fig. 7. Two vanes side by side, *from main part* of a feather of *T. colubris*, showing one of the ways of carrying pollen-grains.

Fig. 8. Two vanes side by side of the same feather *from the base*, showing another way of carrying pollen-grains.

Fig. 9. One-half of a vane showing thistle-like structure at end of a feather, also showing another method of carrying the pollen-grains between two barbs. Pollen adheres to these feathers by aid of the sticky secretion of plants.

EDITORIALS.

—THE U. S. Geological Survey has entered on a new era of its history, and one which will have an important bearing on the study of geology in this country. We look for a material improvement in the administration of this public trust, as compared with its history during the past ten years. Major Powell, who has just retired from the position of director, tried a good many experiments which were not judicious, and proposed to try others which were fortunately suppressed. It is to be greatly regretted that the Survey did not at the outset establish a modus vivendi with either the U. S. Engineers, or the Coast and Geodetic Survey, so that the topographic work could have been done by one or the other of these competent corps of men. They possessed the plant, both in men and in apparatus, but instead of arranging with one or the other of them, director Powell preferred to expend a large part of the resources of the Survey on this branch of the work. The topographic corps of the Survey constituted, perhaps, two-thirds of the entire force, and the expenditures for it were of course proportionately great. The new director, Dr. Walcott, inherits this incubus from his predecessor. The problem of its continuation as a part of the Survey's work is a serious one, in view of the reduced appropriations now granted by Congress. It may be considered in connection with the fact, that ultimately the geology of the United States will be represented on maps of first class topographic quality. It is frequently asserted that the maps hitherto produced by the Survey have not that high accuracy which the subject demands, although not without value for general purposes. The production of the best grade of map will probably require a greater outlay than has been heretofore granted for this purpose. Since the appropriations are less than heretofore, the assumption of this work by one or the other bureaus of the Government already mentioned would seem to be a necessity.

The importance of such a transfer is obvious from another point of view. The department of paleontology was inexcusably neglected by Major Powell, who had little appreciation of its importance to geology. So far as concerns vertebrate paleontology, the Survey's publications are distinguished by their absence, as based on collections in this department, for which large sums were expended. This failure of the Survey to render any equivalent for the expenditure, led Congress to restrict definitely the appropriation for this object, which was a misfortune for which Major Powell is responsible, since the management of that department was of his own selection. The amount of work done in other departments of paleontology by the Survey is much less than it should have been. It is not necessary to call the attention of the present director of the Survey to the subject. An able paleontologist himself, he is not likely in his administration to neglect a department which is the life-blood of the science of geology. And, apart from its relations to geology, it has an especial importance of its own, which it is the business of a great government survey to foster.

In the later years of the Powellian period, the Survey made up for lost time in the quantity and quality of its stratigraphic work. It may be truthfully said that during the last five years no organization of the kind has turned out so large an amount of excellent original stratigraphic work at various and remote parts of the country. The habilitation of the Columbia, the Appomattox and Tuscaloosa formations of the Atlantic slope, and the correlation of the older paleozoic beds of the Appalachian Mountains must be credited to the geologists of the Survey. So also the definition of the epochs of the Cretaceous and Cenozoic beds of the coastal plain. The analysis of the strata of the Sierra Nevada has been immensely advanced, and much work has been done in the field of glacial geology. We look for a continuation of this work; and if some of the omissions of the past are supplied, the Survey will probably have the unanimous support of the scientific world.

—The publication of the geological map of Pennsylvania by the State Survey marks an era in the history of that organization. Professor Lesley, the director, has issued an atlas containing the map of the State in four sheets, together with detailed maps of Bucks and Montgomery Counties, with maps of the bituminous coal areas of the western counties, with others. An atlas of county maps is issued at the same time. The geological maps are well colored, and are a credit to the State. The amount of the appropriation did not permit of the insertion of the topography by contour lines in either the State or County maps. This is to be regretted, but may be left for some future survey, which may issue a new edition. An important and obscure problem has been greatly elucidated by Dr. B. S. Lyman, the author of the Montgomery-Bucks map, i. e., the analysis of the red beds which are generally referred to the Trias. His division of the formation into several horizons will aid research, and we await the evidence of their paleontology to determine the relations of some of them. Another problem of even greater significance awaits the labors of the Survey. This is the discrimination of the Cambrian and Ordovician beds of the eastern border of the mountains. The Calciferous and Trenton limestones both exist in this series, but they are still included in one formation by the present survey, as they were by the first survey, as No. II. Walcott has already made some progress in this direction, and it is certain that many important results will be obtained by further research.

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RECENT LITERATURE.

The genus Salpa.[1]—The Johns Hopkins Press has issued the second of the series of "Morphological Monographs," in the shape of a magnificent treatise on the genus Salpa by Professor W. K. Brooks. The monograph is an exhaustive one, without which no working library can afford to remain. It includes a brief but valuable survey of the anatomy of many species, a detailed account of the development of the solitary form from the egg, and of the chain Salpa from the stolon. The systematic position of Salpa with reference to other tunicates is discussed, and this leads the author to a wide biological consideration of the primitive pelagic fauna and the origin of the Metazoa. The evidence on the origin of the Chordata, to be gathered from the tunicates, is presented and is shown to be in opposition to the annelidian hypothesis of the derivation of this group. Dr. M. M. Metcalf contributes the final section, a careful study of the eyes and subreural gland of Salpa.

The chapter on the egg development of the solitary Salpa is especially interesting and suggestive. An outline of this remarkable development is as follows: The germ mass is present in the embryo of the solitary form, and extends into the stolon as the latter grows out. It is differentiated into a superficial epithelium and an inner mass of ovarian ova, which in the mature stolon form a single row. When the stolon is constricted to form the chain of salps, each Salpa body gets its particular portion of the elongated germ mass. In most species this consists of a single egg with its surrounding epithelium. The latter is differentiated into testes, follicle, and fertilizing duct, i. e. a tube attaching the egg to the dorsal wall of the chain salp, through which the spermatozoa pass to reach the egg—the egg itself lies in a blood sinus of the chain salp. It is evident from these facts that the alternation of generations in Salpa differs from the typical alternation of generations, in that the solitary form does not arise from the chain Salpa, but from an egg passed into the chain Salpa from the preceding generation of the solitary form.

As the embryo grows, it pushes out of the blood sinus in which it lies at first, into the cavity of the cloaca, driving the wall of the cloaca before it. From the dorsal wall a complicated system of covering

[1]The genus Salpa, by William K. Brooks. Baltimore, The Johns Hopkins Press, 1893.

embryonic membranes is formed. The inner end of the embryo remains exposed to the blood sinus of the chain salp, and from it the placenta is formed. The placenta of Salpa is fundamentally different from that of the Mammalia. It is merely a portion of the embryonic body through which the blood of the chain salp circulates. It appears to be exclusively a nutritive organ, not respiratory. The stream of water constantly passing through the cloaca of the chain salp and bathing the body of the embryo, makes a special respiratory organ unnecessary. The placenta performs its nutritive function in a way very different from that of the corresponding mammalian organ. In Salpa the placental blood current nourishes the placenta itself and causes the cells to multiply. The latter migrate into the body cavity of the embryo, where they degenerate and are used as food.

The very remarkable character of the egg development is due to the peculiar behavior of the follicle. During the segmentation of the egg, the follicle undergoes a considerable increase in size. Its cells proliferate and the follicle assumes a shape, which may be likened to that of a mature Graafian follicle of the vertebrate ovary. That is, there is a superficial (or somatic) layer of the follicle, connected over a small area with a central mass (visceral layer), the two elsewhere separated by a cavity. The blastomeres, which are forced apart by the growth of the follicular tissue, lie in the visceral layer and the region where visceral and somatic layers are connected. The follicle now proceeds to develop, as if it were going to form the embryo, while the blastomeres remain few in number, scattered about in the midst of the mass of follicular tissue. It is impossible without figures to explain the way in which the follicular tissue is folded and hollowed out, to form the various parts of what appears to be the embryo. It may be said in a word that the follicular tissue gives rise to a body, which is a "simulacrum of the embryo." In this body, pharynx, cloaca, gill and gill-slits, are all developed, but are lined with the follicular cells of which the great mass of the body is composed. As the various organs are outlined in the follicular tissue, the blastomeres take up certain more or less definite positions with reference to each organ. Finally the blastomeres begin a rapid growth, and in each organ and throughout the body they take the place of the follicle cells, the latter degenerating and being ultimately used up as food. Thus in fact the Salpa embryo, like that of other animals, is derived from the egg cell and not from the follicle, as some investigators have held.

Professor Brooks suggests an explanation, which is probably the true one, of the behavior of the follicle in the Salpa embryo. It is well known that in many tunicates the follicle cells migrate in between the blastomeres, more or less completely surrounding the latter, in which position they are finally used up as food. And the peculiar behavior of the follicle in Salpa is probably to be explained on the theory that Salpa has had an ancestor in which the follicular tissue persisted late in the development, and was so accurately disposed around and between the organs as to form what might be called a cast of the embryo.

In the modern Salpa, as in the hypothetical ancestor, the follicular tissue develops into a cast of the embryo, but the blastomeres instead of leading the way as they doubtless did in the ancestral embryology, are now so retarded in their development that they do not begin to build up the embryonic organs until the follicular cast is well nigh completed. H. V. WILSON.

Bateson's Dictionary of Variaton.[1]—In this work the author has collected a great many examples of variations from normal structures found in animals. These include both absolute abnormalities and variations which are in the line of evolution. The work is a useful one to all zoologists aud students of evolution, as furnishing examples of variation in groups with which they are not personally familiar. It will, however, not take the place with any specialist of his knowledge of the subject matter of his own studies. It is not to be supposed that its author intended that it should. A dictionary of variation of all animals would be a detailed work on zoology in general, where the normal characters of all species should be stated, in order that it might be shown what constitutes variation. Such a work could only be produced by the cooperation of a large number of "species naturalists." Embryologists and histologists would be wholly unfit for the task. Perhaps it was a sense of this deficiency which led Mr. Bateson to prepare this work; for otherwise it is difficult to imagine why an expert in any branch of zoological sciences should attempt the task, unless it should be designed for amateurs and general readers. While preparing the work, its author neglected one of the richest mines of information as to normal variation. This is found in the writings of American specialists in vertebrate zoology, where the subject has been treated in greater detail, and with greater wealth of material than exists in the literature of any other country. The book is well illustrated, which greatly enhances its value. We recommend it for study to persons who are doubtful in their opinions on the subject of organic evolution.

[1]Materials for the Study of Variation treated with especial Regard to Discontinuity in the Origin of Species. MacMillan & Co., London, 1894, pp. 598.

General Notes.

GEOGRAPHY AND TRAVELS.

Antarctic Exploration.—The most important geographical discoveries made in the Antarctic regions since Ross traced a part of Victoria Land's coast, and saw its smoking mountains, fifty-two years ago, have just been reported by an old and well-known Norwegian whaler, Captain Larsen, who, by this time, is undoubtedly on his way home with a cargo of seals. His discoveries were made in the latter part of November and early in December last, on the steam whaler Jason. Later he went north to the Falkland Islands, where he found an opportunity to send home his log for this period. He then returned to the sealing grounds near the Antarctic Circle. His log was forwarded from Norway by Mr. Christensen of Sandefjord to Dr. John Murray, the well-known Scottish scientist and member of the Challenger expedition, who has just published the extract from the Jason's journal in the *Scottish Geographical Magazine.* Only a few lines, including the latitude and longitude attained, are given in the log to each day's events, and the narrative is therefore lacking in detail. When Capt. Larsen returns to Europe, he will doubtless give a full account of his interesting voyage.

If the reader will refer to a map of the Antarctic regions, he will see a large land mass, known as Graham's Land, lying across the Antarctic Circle, south of Cape Horn. Except Victoria Land, which lies on the other side of the Antarctic area, Graham's land is the largest bit of *terra firma* that has yet been found in South Polar waters. It was discovered by John Biscoe in 1831, and a brief allusion to the exploration there is necessary in order to understand what Larsen has achieved. Biscoe skirted its lofty western coast for about 200 miles, and, landing on little Adelaide Island, not far from the mainland, he was the first to set foot on shore within the Antarctic Circle. No one ever saw any other part of Graham's Land except Ross, over fifty years ago, and the Scottish and Norwegian whalers who were there in the season of 1892-93. Capt. Larsen's recent achievement was to steam for days along the east coast of the unknown land, and when he was finally compelled to turn north again, he could still see the lofty summit of the mainland stretching south and east as far as the eye could reach. Dr. John Murray and other authorities believe that in those days he was skirting a part of the coast of the great Antarctic continent, and while he was adding to our knowledge of the coast lines around the South Pole, he also discovered some volcanoes in a highly active state, showing that Plutonic energy in that part of the world has not yet died out, and that its activity there is more widely distributed than we had any reason to suppose.

The ice conditions greatly favored Capt. Larsen, for he found a comparatively open sea, and was able to advance about one hundred miles south of the Antarctic Circle. Only the year before the whalers had found the sea packed with ice almost to the extreme northern part of Graham's Land. As they looked south they saw a chain of bergs towering high above their ships, which effectually barred their progress in that direction. After Ross, in his sailing ships Erebus and Terror, had discovered Victoria Land and skirted its coast for hundreds of miles, he spent almost the entire season of 1842-43 near the north end of Graham's Land trying in vain to push his way through the ice-encumbered sea and the great chain of bergs. He was not able, however, to advance toward the south until he went far east, out of sight of Graham's Land, whose mystery he had hoped to solve. Larsen had a very different experience in November and December last. The weather was fine and warm, and there was plenty of sunshine and little fog. The air and sea teemed with animal life, for many birds, whales and seals were seen, and, best of all, the white, east coast of Graham's Land, rising here and there into lofty peaks, stood out clearly in view. He followed it straight to the south, until, at its furthest point, he saw it rising to still loftier heights and stretching away to the southeast and east.

From Capt. Larsen's log, and from the observations of the whalers at the north end of Graham's Land, in the previous season, we are able to get some idea of this *terra incognita.* According to his log, Capt. Larsen steamed along this east coast for 230 miles, the coast line stretching away a little east of south, a high, rocky shore, most of it a few miles west of 60° west longitude from Greenwich. Right at the Antarctic Circle is a very high peak, most of which is bare of snow. The shore front is skirted with an ice barrier that runs about five miles out to sea, and is from twenty-five to sixty feet high. The land is covered with an ice cap and glaciers flow down the valleys, but in the narrow, northern part of the land they are, of course, small, and do not produce icebergs over sixty to seventy feet in height. In 1892-93 the whalers saw in the neighboring waters bergs that were 200 feet or more in height, and their depth below the surface must have been at least 1,400 feet. It is certain that they come from some more southern part of the Antarctic region.

Skirting the shores, Larsen saw numbers of islands and rocks, all volcanic and mostly basaltic, rising out of the sea almost as perpendicular as the icebergs, and presenting little surface on which snow can rest. He succeeded, however, in landing on Seymour Island, and pushed some distance into it, though the walk was most difficult across the deep valleys and over the high rocks. Great numbers of penguins had their nests there, and in the interior he found several dead seals. These penguins are peculiar to the Antarctic regions, and their rookeries are very curious. They are occupied by countless numbers of the common black-throated penguins, and the nests are crowded together in square blocks formed by paths intersecting one another almost at right angles. The whalers of the previous year said that these rookeries, viewed through a telescope from the ship's head, had the appearance of hair brushes, the penguins representing the bristles.

It was about eighty miles north of the Antarctic Circle that Larsen discovered a chain of five little islands, extending in a straight line from northwest to southeast. The most northern is about ten miles from the mainland. Two of these islands are active volcanoes. The captain and his mate fastened on their snow-shoes and crossed on the ice to one of the islands. A large volume of smoke poured from both of the volcanoes, but neither of them was ejecting lava or solid matter at the time, though the ice in the neighborhood was strewn with volcanic stones that had recently been hurled out of the craters. There was no snow on these volcanic masses.

On his journey south, Capt. Larsen saw many whales and seals. It is well-known that the Dundee whalers turned their attention to the Antarctic regions in 1892, in the hope of finding the true whalebone whale, which Sir James Ross believed he saw there. The Dundee fleet, however, saw neither this variety nor any sperm whale. They saw any number of finners, which were so tame that the ships actually struck them sometimes before they would get out of the way. Now and then these enormous creatures, not less then eighty feet in length, jump like a salmon, every portion of their bodies being clear of the water. The hunchback whale, which was found there in great numbers, is another interesting species. The whalers say that neither salmon nor trout fishing can equal the hunchback for sport. Larsen hunted one which, on being harpooned, ran the five lines in the first boat straight out and got free. Four additional harpoons and six rockets were fired into it. It fought a thirteen hours' battle and then escaped, taking with it a good deal of line, two of the harpoons, and all of the rockets. Larsen saw three other species of whales there, but none of much commercial value, while the seals are desirable chiefly for their oil.

The most southern point reached by Capt. Larsen was in 68° 10 south latitude. Had he advanced a few miles further, it would have been necessary to turn quite abruptly to the east, for he saw the shore line bend around till it ran almost due east and west, and behind it was high land covered with snow. He had followed the coast on the east side of Graham's Land as far as Biscoe had traced it on the west. On the map the reader will find Alexander I. Land, which is due west of the high land seen by Larsen when he turned his ship to go north again. Dr. Murray believes that Alexander I. Land is a part of the west coast of Graham's Land, and that this landmass, which Biscoe and Larsen proved to widen rapidly toward the south, is only a peninsula of the continent of Antarctica.

It is interesting to consider the geographical significance of Larsen's voyage. Our maps show that all around the Antarctic area, in the neighborhood of the South Polar circle, bits of land have been discovered. It is noteworthy that scarcely one of these bits of land has been explored in its whole extent. The explorers did not ascertain whether the land they saw was islands or projections from some great landmass. Discoverers have very rarely been able to effect a landing on account of the belt of pack ice or ice floes, often ten to twenty miles wide, that separated them from the shore. There are several excellent reasons why many of the leading geographers and geologists believe that these various lands—Victoria, Graham, Wilkes, Adelie, Clarie, Sabrina and Termination Lands and some others, are merely parts of the outer edge of a large continent. To mention here only one of these evidences, the Challenger expedition, sounding in Antarctic waters, brought to light material which is regarded as strongly indicating the proximity of a landmass of continental proportions. Ross believed this when he was in the region where Larsen has made his reconnoissance. Ross said that though the ice prevented him from taking his vessel south, he believed he could have landed and travelled over the continent. Larsen's work adds strength to the theory, for we see Graham's Land rapidly widening as its coasts are followed toward Victoria Land. A great deal of the area within the Antarctic Circle may be covered with the sea and still leave room there for a land of continental extent. It has been observed, when possible to approach the land, that there is much similarity in the geological structure of the apparently detached masses. Dr. Wild, of the Challenger expedition, has observed that Graham's Land and Victoria Land are remarkable for the height of their mountain ranges, rising from the sea to 7,000 feet in the former, and 15,000 feet in the latter country, and the shores of both are guarded by numerous islands, mostly of volcanic origin. Wild, Murray, and others say that we are justified in concluding that Victoria Land, whose east coast line was traced by Sir James Ross for more than 500 miles, must extend much further to the west and south, and that probably on its ice cap will be found the present position of the South Magnetic Pole.

Dr. Murray points out that the summer excursion of Larsen's little whaler, shows what large additions might, in a short time, be made in our geographical knowledge by a properly equipped expedition provided with steam power. British geographers will be more than ever encouraged, now that the news of Larsen's work has come to them, to redouble their present efforts to induce their Government to send out an expedition. The expenditure will hardly be justified unless the proposed expedition is accompanied by scientific men and fitted with all the apparatus of scientific investigation. Such a party and equipment would enrich almost every department of natural science. There is no doubt that the science of our day is demanding such an investigation, and, in all probability, it will be carried out within the next few years. Not only scientific men, but also a considerable part of the public, would like to know the nature and extent of this Antarctic continent and what may be learned by pushing into its interior. It is highly desirable, also, as the advocates of South Polar exploration have shown, to ascertain the depth and condition of the ice cap, to sound the ocean depths, to learn its various temperatures, from the surface to the bottom, to trawl up the animals on the sea floor, and study the nature of the marine deposits. These are among the questions that explorers will be called upon to solve in the prolific field of South Polar research.—CYRUS C. ADAMS, in *New York Sun.*

MINERALOGY.[1]

Friedel's Cours de Mineralogie.[2]—The first part of a text-book of mineralogy by Charles Friedel covers the field of general mineralogy. In the preface it is stated that a second part, devoted to special or descriptive mineralogy, will be prepared with the assistance of M. George Friedel, the author's son. The book does not claim to be, the author states, a treatise on crystallography or crystal physics, but a practical method of determining minerals on the basis of their morphological, physical, and chemical properties. It is intended for the use of those students who are preparing for the examinations for licentiate in physical sciences, and should therefore be adapted to the needs of college students.

The book contains 416 pages with the subject matter distributed as follows: introduction (giving history of science and fundamental definitions, 16 pages); organoleptic properties, 16 pages; crystallography, 238 pages; physical (and optical) properties, 59 pages; chemical composition occupies the remainder of the book and includes the divisions, blowpipe methods, mineral synthesis, and mineral classification. Under organoleptic properties are included among others, structure, color, lustre, density, external form (with a consideration of pseudomorphs), hardness, and streak. In treating crystallography eight pages are devoted to an exposition of Hauy's *théorie des décroissements.* This is followed by sections on the law of rational indices and symmetry. After deriving the crystal systems, the author gives eight pages to an exposition of Bravais's theory of crystal structure. No mention is made of the work of later writers on this subject, and throughout the book a tendency to utilize mainly the work of French writers seems manifest. The difficulties of translating Levy's symbols into those of Weiss, Naumann, Dana and Miller, makes it necessary to devote thirty-seven pages to crystallographic notation. Twelve of these are consumed by a table giving the equivalents of Levy's symbols in the other notations. An usually large amount of space for a book of this sort is devoted to the representation of crytals, but those which illustrate the book are very poor. Many of the figures are not merely carelessly, but incorrectly drawn. Crystals having a principal

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2]Cours de minéralogie professé a la faculté des sciences de Paris, par Charles Friedel. Minéralogie générale, pp. iii and 416. Paris, 1893.

axis are generally lopsided. Figures 70, 138, 224, 255 and 322 are a few of the incorrectly drawn crystals. Another bad feature of the illustrations is that crystals are not always properly set up but are seen from all directions. The best portions of the work are those which treat optical mineralogy and mineral synthesis. The former is treated without mathematics and in a simple and practical manner. The section on the classification of minerals is very unsatisfactory. What purports to be a history of the subject is given. The systems mentioned are those of Werner, Hauy, Beudant, Delafosse and Dana. Groth's system is not mentioned nor is that of any other modern German mineralogist. A considerable number of pages is devoted to detailed lists of minerals as they appear in the schemes of Werner, Delafosse, and Dana. With the exception of the latter, which Friedel adopts as the one most in harmony with the present state of the science, these lists seem out of place. The book is not provided with an index, but has a somewhat extended table of contents.

As a text-book the work is subject to criticism on account of its classification and arrangement of subject matter, its lack of perspective in the treatment of the different divisions of the subject, its tendency to utilize mainly French investigations and systems, and its faulty illustrations.

Relation between Atomic Weight and Crystal Angles.— In a paper entitled, "Connection between the Atomic Weight of contained metals and the magnitude of the angles of crytals of isomorphous series, a study of the potassium, rubidium and cæsium salts of the monoclinic series of double sulphates $R_2M\ (SO_4)_2\ 6\ H_2O$," Tutton[3] has given the results of a most careful and thorough crystallographical study of an isomorphous series of salts, to determine the kind and degree of effect which the different bases exert upon the crystal angles. The results are very interesting since they seem to show a relation between the atomic weights of the contained bases and the crystal angles. The work involved no less than 9,500 measurements. The crystals were obtained by slow crystallization from cold solutions and ten good crystals of each salt were selected for measurement from a dozen or more different crops. The double salts of the formula $R_2M\ (SO_4)_2\ 6\ H_2O$ containing as univalent metals either potassium, rubidium, or cæsium, and as bivalent metals either magnesium, zinc, iron, manganese, nickel, cobalt, copper, or cadmium, were always pre-

[3]Jour. Chem. Soc. London, Trans., Vol. LXIII, (1893), pp. 337–423.

pared by mixing solutions of the two simple sulphates in equal molecular proportions. The study shows that the bivalent metal exerts no appreciable effect on the crystals, the predominant effect being due to the univalent metal present. The crystals of the potassium, rubidium, and cæsium salts have each a peculiar habit, that of the rubidium being intermediate between the other two. The axial angle β increases from the cæsium, through the rubidium to the potassium salt, its value in the rubidium salt being midway between the values in the cæsium and potassium salts. This is in close correspondence with the differences between the atomic weights of those bases. Tutton says "The relative amounts of change brought about in the magnitude of the axial angle by replacing the alkali metal potassium by rubidium and the rubidium subsequently by cæsium, are approximately in direct simple proportion to the relative differences between the atomic weights of the metals interchanged." The other crystal angles of the rubidium salts are likewise intermediate in value between those of the potassium and cæsium salts, but they do not show the same relation to the atomic weights of the alkali bases, the maximum deviation from such a relation being found in the prism zone. As these angles are for rubidium nearer to those of potassium than to those of cæsium, the author thinks that as the atomic weight of the alkali metal introduced gets higher, the effect of the metal on certain angles increases beyond a mere numerical proportion. Professor Tutton announces that this communication will be followed by another, which will discuss the changes in the optical constants of the crystals due to the same chemical substitutions.

Spangolite from Cornwall.—Miers[4] has found in a collection of Cornwall minerals presented to the British Museum, small crystals of the new mineral spangolite described by Penfield in 1890. The Cornwall crystals show the hexagonal prism, pyramid, and base. Their association is remarkably like that of Penfield's spangolite, as they occur with cuprite and its alteration products. From the characters of the associated liroconite and clinoclase, Miers thinks that there can be no doubt that the specimen is from St. Day, near Redruth.

Eudialite from the Kola Peninsula.—The occurrence of eudialite in the nephelene syenite and pegmatite of the Lujawr-Urt and Umptek in Russian Lapland, recently mentioned by Ramsay, has now been studied in detail.[5] The crystals have developed on them the

[4]Neues Jahrbuch, 1893, II, 174.

[5]Neues Jahrbuch, Beil. Bd., VIII, (1893) 722.

forms R,—½R, ¼R,—2R, ∞ R2, ∞R, and oR. The axial ratio is a:c =1:2.1072. The mineral has good cleavage parallel to the base and one varying from very good to poor runs parallel to the second order prism. The color is usually cherry to garnet red. The crystals are specially interesting because of a marked zonal structure and of a division into sectors having differences in double refraction. Some of these sectors have positive and others negative double refraction. Like the eudialite from Magnet Cove the crystals are optically anomalous, sometimes having biaxial character with optical angle as large as 15°. On heating the sections of the crystals to a temperature at which boracite had become isotropic, all the sectors of the field seemed to give negative double refraction. Ramsay finds evidence that the different zones of the mineral possess different specific gravities as well as different double refraction, and he considers this to be due to isomorphous growth together of eudialite and eucolite. He shows that as regards axial ratio, specific gravity, double refraction and optical character, there is a gradation from the eucolite of Arö through the eudialites of Umptek and Kangerdluarsuk to the eudialite of Magnet Cove.

PETROGRAPY.[1]

The Ejected Blocks of Monte Somma.—Johnston Lavis[2] has begun a thorough study of the ejected blocks of Monte Somma, with especial reference to their petrography and the nature of the metamorphic changes that have been produced in them by the lavas by which they were enclosed. The druse minerals of the blocks have long been known, but their nature as rocks has been left uninvestigated. The author proposes to study in detail about 700 specimens of the blocks, including many varieties. He begins by describing some 30 that were originally stratified Cretaceous limestones containing carbonaceous material. The first stage in their alteration seems to be the conversion of bituminous substance into graphite, and the crystallization of the rock into marble. The crystallization has not destroyed the original bedding bands, nor the most delicate structures exhibited by them, hence it is assumed that fusion or softening of the rock did not accompany the crystallization processes. A few olivines were formed at this tisme, and these consequently are the first products of the metamorphosing agency. They appear principally as inclusions in the calcite. In the next stage of alteration the graphite disappears, and a saccharoidal marble results. This contains more or less colorless olivine, and passes rapidly into a mass of olivine, colorless pyroxene, wollastonite and biotite, where impurities were present in the original rock. In the earlier stages of metamorphism the calcite and the silicate minerals will exist in different bands, but in later stages silicates and calcite intermingle, and finally a purely silicate rock results. The order in which new minerals seem to develope is thought to be the following; olivine, periclase, humite, spinel, mica, fluorite, galena, pyrite, wollastonite, garnet, vesuvianite, nepheline, sodalite, feldspar, secondary calcite, tremolite, brucite. The article is illustrated by three lithographic plates. It will repay close study by students of contact action, as we have recorded in the blocks the effects of the action of a magma upon a limestone, in all its stages.

Phonolites from the Black Hills.—The sanidine-trachyte described by Caswell[3] from Bear Lodge in the Black Hills, has been

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville. Me.

[2]Tarns. Edin. Geol. Soc., VI, 1893, p. 314.

[3]U. S. Geog. & Geol. Survey of Rocky Mts. 1880. Cap. VII, p. 471.

reexamined by Pirsson,[4] who finds it to be a phonolite with phenocrysts of anorthoclase and pyroxene, in a groundmass of the usual components of phonolite. The anorthoclase has the composition:

SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O	K_2O	H_2O	Total	Sp. Gr.
66.44	19.12	.56	tr	7.91	5.10	.57	= 99.70	2.585

The nepheline is all in the groundmass where it appears as idiomorphic crystals. The density of the rock is 2.582 and its composition:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	BaO	MgO	Na_2O	K_2O	H_2O	Cl	SO_3	Total	Cl	
61.08	.18	18.71	1.91	.63	tr	1.58	.05	.08	8.68	4.63	2.21	.12	tr	= 99.86	—.03	= 99.83

A second occurrence of phonolite within the same region is in a dyke just south of Deadwood. It consists of phenocrysts of reddish feldspars and black hornblendes that approach barkevikite in properties. The rock from the Black Hills sold by the dealers as tinguaite is a dense aggregate of pyroxene phenocrysts in a matrix of feldspar and aegirine, with an occasional patch of nepheline.

The Origin of Norwegian Iron Ores.—The iron and other ores of many of the Norwegian localities are connected genetically with granites and gabbroitic eruptives. The iron ores in veins are supposed by Vogt[5] to be due to contact action between granite and the surrounding rocks. Those connected with the gabbros are basic accumulations, whose origin is ascribed to differentiation of the basic magma. In consequence of this differentiation, which is governed largely by Soret's principle and the differences in density of the various differentiated products, the gabbro splits into labrador-rock and various iron-olivine and iron-pyroxene compounds, and in these latter are accumulations of magnetite and ilmenite large enough to constitute ore bodies. Each of the iron-pyroxene rocks is described by the author and the iron ores associated with them are characterized. The titanium of the iron is thought to have originated mainly in the olivine and other basic components of the normal gabbro.

The Tonalites of the Rieseferner.—The tonalites of the Rieseferner in the Tyrol are again the subject of careful petrographical study.[6] The normal tonalite (hornblende–mica–quartz–diorite)

[4]Amer. Jour. Sci., XLVII, 1894, p. 341.
[5]Geol. Fören Stock. Förh. 13 and 14.
[6]Becke: Min. u. Petrog. Mitth., XIII, p. 379.

which is a coarse granular rock, on its periphery often becomes finer grained and porphyritic. Large biotites and hornblendes are scattered through its groundmass, which remains fine grained, and the rock thus takes on a prophyritic habit. At other times the decrease in the size of its constituent grains is accompanied by a decrease in the proportion of plagioclase and quartz present in the rock and a large increase in the orthoclase present, while hornblende disappears completely. It is unnecessary to give the petrographical details of the author's paper. It should be mentioned, however, that the feldspars are very carefully studied by comparing the differences in their refracting indices, and many new points are brought out concerning their relations to each other. Some of the plagioclases were found to consist of nuclei of basic plagioclase, enclosing areas of a more acid feldspar identical with an acid peripheral zone. The phenomenon is thought to be due to corrosive influences. In addition to the various phases of the tonalite mentioned, the author makes a careful study of the veins cutting them, and of the slight alterations they have suffered and he refers to the existence of gneiss fragments occasionlly met with in their peripheral portions.

Petrographical News.—McMahon[7] cites, as evidence in favor of the eruptive character of the Dartmoor granite, and in opposition to the view of Ussher that it resulted from the fusion by pressure of preexisting pre-Devonian sedimentaries, the following facts. Its apophyses cut the surrounding rocks. The metamorphic changes effected in the latter are the result of contact action. Finally the other rocks with which the granite is associated show no evidence of the great pressure, to which they must have been subjected if the granite were truly a fused sedimentary.

Associated with the argillites, graywackes and other sedimentary rocks of the Keewatin series near Kekaquabic Lake in Northeastern Minnesota, Grant[8] has discovered volcanic fragmentals and amphibole schists, the former of which are recognized as diabase tuffs and the latter as their recrystallized representatives.

A quartz bearing leukophyre variety of diabase porphyrite, forms intrusive layers in the Carboniferous schists at the Hernitz Mine near Saarbrücken in the Pfalz.[9] The rock was regarded by Weiss as a melaphyre.

[7]Quart. Journ. Geol. Soc., XLIX, p. 385.
Proc. Somerset Arch. & Nat. Hist. Soc., Vol. 28, p. 892.
[8]Science, XXIII, 1894, p. 17.
[9]Laspeyres: Corr. Blatt. Naturh. Ver. Bonn., 1893, p. 47.

The tuffs found with the nepheline leucite basalts of the Dauner region in the Eifel are made up of augite, mica, and olivine fragments, augite crystals, glass particles and lapilli cemented together by quartz and felspar which represent an original glassy cement.[10]

On the west coast of the Island of Celebes, Wichmann[11] finds boulders of an epidote glaucophane-mica schist, supposed to be associated somewhere in the interior of the island with mica quartzite.

[10]L. Schulte: Verh. d. Naturh. Ver. Bonn., 1893, p. 295.

[11]Neues Jahrb. f. Min. etc., 1893, II, p. 176.

BOTANY.[1]

Abnormal Plant Growths.—*Trillium grandiflorum* Salisb., is noted for its variableness, but a specimen brought in by one of our pupils, this spring, exceeds anything I have seen in this respect. The flower is double, having two sets of sepals, and two of petals. Both sets of sepals are of the usual form and color. The outer petals are striped like ribbon-grass, except the half of one which is white. The inner ones are white, except a thread of green through the center of one. There are three stamens—one normal, one a filament without an anther, and the other expanded into a half-sized petal, concave on one side where a thread of gold, about the length of the anther, seems to be holding loyally to duty. The ovary is of usual size, the styles rather small—one smaller than the others. Near the top of one of the carpels arises an outgrowth about half an inch long, white, doubled together, and drawn over at the top like a hood. To add to the general confusion, there are, on the edges of this growth near the top, two pollen-bearing lines about an eighth of an inch long.

A member of my botany class, Mr. Cheshire Boone, found a specimen of *Hepatica acutiloba* DC., with two flowers on one scape. The second flower arises from the axil of a linear bract a little above the middle of the scape. It is on a peduncle an inch long, and is about half the size of the upper flower.

Another unusual form found this spring is *Viola palmata* L., var *cucullata* Gray, with all of the petals emarginate.

State Normal School, LUCY A. OSBAND.
Ypsilanti, Mich., May, 1894.

The Approaching Meeting of the A. A. A. S.—The meeting of the American Association for the Advancement of Science, this year, from August 15th to 24th, promises to be of great interest to botanists. It is to be held in Brooklyn, N. Y., within a few hours' ride of the homes and laboratories of probably one-half of the working botanists of the country, which may be counted upon as insuring a large meeting. Added to this is the fact that at this time will occur the first meeting of the American Botanical Society, which must attract many of our most earnest workers.

[1]Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska,

The Completion of Coulter's Texan Flora.—Within a few weeks, botanists have received copies of Part III of Dr. John M. Coulter's "Manual of the Phanerogams and Pteridophytes of Western Texas," published by the Department of Agriculture, as one of the Contributions from the U. S. National Museum. A glance over its pages shows it to be an important contribution to North American botany, covering, as it does, a region whose botany has hitherto been scattered through many different reports and papers. That the work is well-done, need not be said of anything from the masterhand of Dr. Coulter, who has here again shown his ability to make a much needed book. This volume carries southward the area covered by Coulter's "Rocky Mountain Botany," and gives to the author a kind of "preemption right" to a belt of botanical territory stretching from the Canadian line on the north (N. Dakota, Montana and Idaho) to the Mexican boundary on the south (Texas and New Mexico). It will clearly be his duty to enlarge his "Rocky Mountain Botany," so as to take in the territory of this Texan Flora; then by adding the Arizona-Nevada region, make it cover the whole of the Western Highlands, from about the 100th meridian to, but not including, the Pacific Coast Region. Such a "Botany of the Western Highlands" would, on many accounts, be much more likely to be successful than the two or three manuals which it now seems probable we are to have for this region.—Charles E. Bessey.

ZOOLOGY.

An Australasian Sub-family of Fresh-water Atherinoid Fishes.—Mr. J. Douglas Ogilby, of the Australian Museum, of Sydney, has recently sent me a photograph and description of a new species of a genus called *Aristeus* by Castelnau. This genus is of much interest from a morphological as well as geographical point of view. Mr. Ogilby has asked, "Is it an Atherinid and allied to *Nematocentris?* or should a new family be formed of it?" Mr. Ogilby, unlike the original describer, is quite happy in his appreciation of its affinities.

The genus *Melanotænia* was proposed by Gill in 1862 (Proc. Acad. Nat. Sci. Phila. 1862, p. 280) for a fish called *Atherina nigrans* by Richardson, and was subsequently renamed *Nematocentris* (Peters, 1866), *Strabo* (Kner & Steind, 1866), and *Zantecla* (Cast., 1873). It has been generally referred to the *Atherinidæ*, but Kner and Steindachner were disposed to associate it with *Pseudomugil* in their family *Pseudomugilidæ*, and Castelnau proposed a new family, *Zanteclidæ*, for it. No satisfactory family characters were given.

The genus *Aristeus* was described by Castlenau in 1879, and by him referred to the family *Gobiidæ*. Steindachner, in a notice of the genus (Zool. Jahresber. 1879, p. 1061), happily hit at its relations in the words, "*Aristeus* N. G. Casteln. (wahrscheinlich.=Nematocentris, d. Ref.)."

There are two specially interesting features of these genera.

(1) They deviate from the typical Atherinids in the elongated anal fin which advances far forward, and with the advance are coordinated an advanced position of the anus and of the ventral fins, whose roots are little behind the bases of the pectoral fins.

(2) The species of both genera are confined to the fresh-waters of the Australasian realm and the constituent group is thus one more of the groups limited to a single realm.

The deviations of the genera from the typical *Atherinidæ* appear to be sufficient to warrant their segregation in a peculiar sub-family which may be named *Melanotæniinæ*. But confirmation by anatomical characters are very desirable. The sub-family may be defined provisionally, as follows:

MELANOTÆNIINÆ. Atherinids with a spinous dorsal, whose foremost spine is robust and rest weak, a very long anal, and thoracic ventral fins. Inhabitants of the fresh waters in the Austrogean (Australasian) realm.

The genera may be differentiated as follows:

MELANOTÆNIA. Melanotæniines with a little compressed fusiform body, slightly curved dorso-rostral contour, and a blackish lateral band.

RHOMBATRACTUS. Melanotæniines with a much compressed rhombo-fusiform ventradiform body, emarginate dorso-rostral contour, and no distinct lateral band.

Aristeus having been used in 1840 by Duvernoy for a genus of Crustaceans, is unavailable for the group so-called by Castelnau, and *Rhombatractus* is used as a substitute.

Rhombatractus has a curious superficial resemblance to a toxotid on account of its compressed body, declining back and ventradiform contour, but the head is that of an atherinid.

It may be that the Melanotæniines should be accorded family rank, but further data are desirable before such a claim is recognized. One of the subordinal characters of the Percesoces, in any case, must be modified to fit these fishes.—THEODORE GILL.

EMBRYOLOGY.[1]

Earthworm Phylogeny.—The great accumulations of anatomical facts that the study of exotic earthworms has brought into existence during the past few years is now to be made more intelligible by the added facts of comparative embryology. It is a fitting tribute to one who has inspired so much of this recent exploration into this field that Bourne's paper[2] upon the development and anatomy of certain Indian earthworms should appear in the complimentary number of Lankester's Quarterly Journal.

When the study of exotic earthworms had shown that there might be large numbers of micro-nephridia, present in any segment and when it was even claimed that tubules of these micro-nephridia might anastomose to form a connection from segment to segment, the view of Lankester became less tenable as it became more probable that the ancestral condition of the earthworm was not what the common European earthworm had led one to expect.

It seemed probable that the ancestor of the earthworm might have had a large number of nephridia and of setæ and no definite segmental arrangement of these structures.

Now, however, we learn from Bourne's paper that in the development of *Mahbenus imperatrix* and *Perichæta* the vexatious micro-nephridia arise as out-growths from provisional mega-nephridia and are thus of apparent secondary value. The ancestral condition of a pair of nephridia for each segment being clearly indicated even in these cases. The connection of nephridial tubes, the so-called "plecto-nephric" condition does not, apparently, exist at all, certainly not in the embryo.

We learn also that in these exotic forms, such as Perichæta (which is common with us in green-houses) the large number of setæ found in a band around each segment are not to be regarded as of ancestral value since they all arise from two germ bands that then give rise to matrices which grow laterally in each segment and form the numerous setal sacs by segregation of cells and by division of matrices. The setal germ bands in turn are regarded as probably arising from Wilson's lateral teloblastes.

Besides thus throwing much light upon the probable ancestral con-

[1] Edited by E. A. Andrews, Baliimore, Md., to whom contributions may be sent.

[2] A. G. Bourne. Q. T. Mic. Anat., April, 1894.

dition of seta of nephridia in the earthworm group the author's more detailed future work promises to add to our knowledge of other difficult points, such as the origin of the nerve cord, which it is here stated arises from two distinct matrices.

Bourne is inclined to regard the germ bands as the source of all the metameric structures. The body wall muscles would be of other origin. The segmentation of the digestive tract a secondary state forced upon it by the mesoblastic structures.

Determination of Sex.—What at first sight appears to be an interesting and valuable addition to the facts tending to show that favorable conditions lead to the production of female offspring and unfavorable conditions to the production of male offspring is to be found in a paper by F. Braem[3] upon the development of a marine polychætous annelid, *Ophryotrocha puerilis*. Here, however, as in some other cases, the evidence is really of little value as may be seen from the facts given by Korschelt in a paper immediately following that of Braem.

Braem found in attempting some regeneration experiments in addition to his study of the ovaries and testes that in one case there was a remarkable change of sex. A female annelid full of ripe eggs was cut into two pieces, the anterior containing 13 and the posterior 22 segments. After three weeks the anterior part had regenerated seven segments.

It had become smaller and appeared to be starving while the eggs had disappeared. When sectioned it was found to have changed its sex, containing only testes. A few cells remained that were ova in process of formation before the sexual glands changed their character and began to form sperms.

The author would refer this transformation into a male to the unfavorable conditions, to the fact that the creature was not sufficiently nourished to form ova as well as to regenerate the lost part of its body.

Now Korschelt in a careful study of the anatomy of this same small annelid finds that besides males and females, there are also hermaphrodites (in fact Braem found one such case) in which the same gland makes both ova and sperms. Among 30 individuals 6 were female, 7 were male, 8 were apparently female but contained male cells both young and full formed, white the remaining 9 were apparently male though containing ova in the testes. Thus the hermaphrodite state is the more frequent one, to judge from these few cases.

[3] Zeit. f. wiss. Zool., 57.

Though there is no evidence that the male and female states may normally succeed one another in the same animal, yet when this, apparently, was the case in one specimen operated upon by Braem, we are not justified in regarding this is as a result of the operation or as in any way connected with it, since it may be that it would have taken place under the normal conditions. Moreover, and this is more important, the animal full of eggs may very well have been a hermaphrodite from the first, and have merely re-absorbed its ova under the stress of regeneration, so that we know nothing as to any real change from female to male in this case.

PSYCHOLOGY.

Mutualists.—Many animals which are found associated with other animals and which are usually termed parasites are, in fact, true mutualists. I mean by the term, mutualist, an animal which gives a *quid pro quo* or specific beneficial service to the host which affords it sustenance and domicile. A true parasite feeds on the food or the physical juices and structures of its host without rendering any reciprocal service whatever. Thus, the family *Pediculidæ* (*P. corporis, P. capitis, etc.*), found associated with man, are true parasites, while the family *Riciniæ,* found associated with birds, are true mutualists. I am fully aware of the fact that I antagonize the opinions of entomologists (who regard all these little creatures as parasites which are to be destroyed as soon as discovered, inasmuch as they consider them detrimental to the health of the animals upon which they are found), for I consider most of them absolutely necessary to the health and well-being of their hosts, and their absence to be an indication of disease in some form or other in those animals on whose bodies they are not to be found. Careful observation has taught me that these faithful little hygeinic servitors immediately abandon the bodies of fowls which are the victims of cholera and kindred diseases. Porcine mutualists behave in a like manner when their hosts become diseased. I had thought with others until recently, that these corporal scavengers and toilette assistants were parasites, but systematic and painstaking observation has taught me otherwise. In the first place, microscopic examination shows that these creatures have no suction apparatus like fleas (*Pulex*) and lice (*Pediculus*) for the purpose of sucking up the blood and juices of their hosts. Their jaws are usually armed with a simple pair of incurvated scrapers with which they scrape the surface of their hosts' bodies. Their stomachs never contain the blood of their hosts, but are always filled with exfoliated epithelium and kindred superficial debris. Supported by these observations alone, the fact at once becomes evident that these creatures are not true parasites ; but there is yet more testimony to be adduced in favor of these hitherto maligned coadjutors and promotors of animal hygiene. If one carefully separates the feathers on the body of a fowl and uses a good lens (10 diam.) he may observe *Liothe pallidum,* a true mutualist, busily engaged in removing exfoliated epithelium (scarf-skin) from the body of its host. It thoroughly cleans its allotted area, scraping away and swallowing all of the waste products of the skin. Again, if the feathers themselves be examined, another mutualist (*Liothe saculatum*) may be seen freshening and beautifying their sheen by taking into its stomach all dead epithelial cells, etc., with which it comes in contact. Mutualists are found everywhere in nature, and wherever found are of essential service and benefit to the animals possessing them. From the giant cetacean to the microscopic rhizopod, from the savage lion to the timid field-mouse, from the kingly eagle to the tiny humming bird, no animal is without them. Butler's epigram:

"Big fleas have little fleas upon their backs to bite 'em;
And these fleas have other fleas and so *ad infinitum*."

is mainly true, only I insist that no true mutualist ever bites its host. Many mutualists never reside wholly with their hosts, but visit them occasionally to render them needful service. The famous crocodile bird visits its host in order to pick its teeth; Buphagus, the surgeon of the buffalo, alights on the back of its host, and, with its sharp, lance-like beak opens the cells of encysted larvæ and removes them; the European starling performs a like service in removing "wolves" from the backs of cattle.

In matters of the toilette many animals are entirely dependent on the ministrations of mutualists. This is notably the case with many of the fish family. I placed two gilt catfish, whose skins had been thoroughly cleaned with a solution of salt water and borax, in a tank of filtered water in which there were no *Gyropeltes*, the mutualists of this species of fish. In two days their skins had lost their beautiful golden sheen and had become dull and lusterless. The fish themselves clearly showed by their actions that they were not in good health. They remained at the bottom of the tank almost without motion. I then took them out and found that their skins were covered with a slimy mucous exudate. I placed them for a few moments in a tank of pond-water in which there were multitudes of *Gyropeltes*. After allowing them to remain in this tank for a few moments, they were removed and examined, and thousands of these mutualists were discovered greedily devouring the mucous. After a day's residence in the pond water their skins had recovered all their lustre and beauty, and the fish showed by their actions that they had regained their health. A truly remarkable mutualist is found associated with the crayfish. It belongs to the genus *Histriobdella*, and its office is analagous to that of the vulture, the jackal, and the burying beetle which remove carrion. It is exceedingly agile and is altogether one of the most unique in appearance of all animals. It may be described as a two-legged worm, which has all the powers of a most accomplished contortionist. The crayfish, after oviposition, carries its eggs beneath its tail, and the *Histriobdella* lives among them. Its office or function is to devour all blighted or unimpregnated eggs and dead embryos, the decay of which might affect the health of its host and progeny. Van Beneden, describing the *Histriobdella* found associated with the lobster, says: "Let us imagine a clown from the circus, his limbs dislocated as far as possible, we might even say entirely deprived of bone, displaying tricks of strength and activity on a heap of monster cannon balls, which he struggles to surmount; placing one foot formed like an air-bladder on one ball, the other foot on another, alternately balancing and extending his body, folding his limbs on each other, or bending his body upward like a caterpillar of the family *geometridæ*, and we shall then have but an imperfect idea of all the attitudes which it assumes, and which it varies incessantly." I once saw one of these little animals stand erect on its legs, then bend its body down between them and, with a quick flirt, turn a complete summersault. I have repeatedly seen this mutualist insert its proboscis into the eggs of crayfish and devour them. Microscopic investigation always showed that the eggs thus attacked were unimpregnated, consequently unfertile. I might prolong this paper by introducing many other mutualists, but think it hardly necessary. I have shown that these creatures subserve a very useful purpose in nature, and that they do not belong to that disreputable class—the parasites.—Jas. Weir, Jun., M. D.

ARCHÆOLOGY AND ETHNOLOGY.

Ancient American Bread.—Mr. S. P. Preston, of Lumberville, told me on April 1st, 1894, that he remembered his grandfather, Silas Preston, telling him how the latter, when a boy living on the farm now owned by Benjamin Goss, in Buckingham township, Bucks County, Pa., had seen Delaware Indians, about the year 1780, encamped in barked-roofed wooden huts near by, pound corn in stone mortars with stone pestles. They mixed the meal with water, and patting the dough into flattened balls with their hands, baked these cakes in the hot embers of their open fires. He did not tell his grandson whether they salted the meal, or—what was more important, if we want to try the experiment—whether the corn grains were pounded when old and well dried, which would be a difficult operation; when green and soft, which would be easier, or after previous parching, which would be easiest of all.

Franklin (Harshberger on Maize, p. 140) speaks of Indians, probably Delawares, parching corn grains in dishes of hot sand and afterwards grinding them to a fine powder, which kept fresh a number of years. Captain John Smith saw Indians roasting corn on the ear green, and when thus parched crisp, bruising it in a "wooden mortar with a polt and lapping it in rowles in the leaves of their corn, and so boyling it for a dainty."

Parching loose grains well stirred in an open iron dish does as well as either of the above methods in my experience and gets over the first and main difficulty of producing the meal or dough with a stone mortar and pestle. This meal, as I have made it, from freshly parched grain, is the easily produced Mexican Pinol, carried invariably on long desert journeys in Chihauhua and Sonora—sometimes seasoned with herbs or parched cocoa shells and generally mixed with sweetened water as a strengthening beverage.

The taste of cakes made of parched meal, I find on experiment, differs as much from that of others made from fresh grain as it does from the flavor of bread made by Mexican Indians from Metate crushed grains previously softened in hot lime water; but, given the meal, the Lenape process of cooking the dough in the embers of an open fire is that to-day in use by the negroes of Southern Maryland and Virginia. In an ash cake baked in the embers before me at Egglestons', Giles county, Virginia, in February, 1894, they reproduced the mode of the

Lenape cook, while with their hoe cakes, originally baked by the cornfield hands on hoe blades thrust into the wattle and clay fire places in log cabins, another Indian cake, that cooked on flat heated stones is imitated.

The Lenape word "Pone" (pronounced by the Delawares *ach pone*, and meaning baked corn bread), much used in Virginia to mean all kinds of corn bread, including the Johnny cake (baked on a greased board like a planked shad), is not needed to show that maize bread cooking—the best of it on the Atlantic seaboard, is a direct inheritance from the Indian.

Virginians justly despise all corn bread made north of Mason and Dixon's line. We use red corn instead of white, say they, which spoils the flavor, grind the meal coarse, which spoils the grain, and lastly, bake the meal (sometimes at mills) to save the frequent grinding necessitated in the South (once a week in summer and once in three weeks in winter) to prevent fermenting which destroys the vitality.

These alleged reasons may not fully account for the abominable corn bread of the North, but it is possible that the Indians had developed valuable modes of preparing the grain of their great plant, which neither Virginian nor Northerner have understood.—H. C. MERCER.

The making of New Jersey Coast Shell heaps in 1780.—To learn from Mr. Preston that even these squatting, half-civilized Lenape, in Buckingham, as lately as 1780, went over to the sea to make shell heaps once a year, is to lessen our surprise at the man-made shell deposits of the New Jersey coast, for if these conspicuous remains of shell feasts were built up, not only by coast-dwelling tribes, but by an Indian population from a good range of interior country, we need not wonder that they are very large or suppose that they are very old.

The Indians were in the habit of going in a body several days' walk, said Mr. Preston, the elder, in April or May to the clam banks of the New Jersey coast, near New Brunswick. There they encamped for several weeks to feast on clams, and when they retnrned, brought to the old and infirm who had remained at home, bundles of clams slung in skins on pairs of poles running from shoulder to shoulder of two men.

Even their stone-pointed arrows were sometimes used, at that time by these tolerated stragglers, who had sold the land they lived on in 1737, as when during mowing season, they shot robins and "flickers" (golden-winged woodpeckers) in black cherry trees with bows and arrows and strung the birds on long cords. Land turtles were cooked for food, as when Mr. Preston saw a woman throw an *apron* full into an open fire, while another poked the tortured creatures back into the coals with a pole till they were roasted. It was remembered as a good joke that during a boiling of lye and soap fat for soft soap, an Indian woman coming to the kettle in the absence of the cooks, was seen to grease her hair with the mixture.—H. C. MERCER.

The Hemenway Collections.—The trustees of the Peabody Museum of Ethnology, in Cambridge, received a letter from Mr. Augustus Hemenway offering them, on behalf of the trustees of the estate of Mrs. Mary Hemenway, the incomparable collection of archeological specimens gathered during the last seven years by Mr. Frank H. Cushing and Dr. J. Walter Fewkes in Arizona and New Mexico.

These collections are not offered as a gift, but merely as a deposit. The trustees of the museum have accepted the loan, and have offered a sufficient space for its display. It is probable, however, that the deposits will amount practically to a gift.

A condition of this deposit is that Dr. J. Walter Fewkes, who has been in charge of Mrs. Hemenway's archeological enterprises since Mr. Cushing was compelled, on account of continued ill-health, to retire, shall continue in charge of the collection, although, of course, under the direction of Prof. Putnam, the curator of the museum.

The collection, which may be divided for convenience's sake into two parts, that formed by Mr. Cushing and that by Dr. Fewkes, is now widely scattered.

The portion excavated in the vicinity of Phenix and Tempe, Ari., by Mr. Cushing, is at present stored in Salem, Mass., while some of the results of Dr. Fewkes' expedition to the Moqui Indians of New Mexico are stored at 42 Mt. Vernon Street, Boston, and the rest are on exhibi tion in the National Museum in Washington.

How soon these portions will be united in Cambridge has not yet been decided, but it is reasonable to suppose by next fall there will be a fairly complete display open to the public at the Peabody Museum.

The indirect cause of these collections was the explorations which Mr. Cushing carried on among the Zuñis of New Mexico. The Zuñis seemed to Mr. Cushing to possess remnants of certain customs and habits which might possibly be referred back to the prehistoric inhabitants of the ancient pueblos or towns, the big, low, communal buildings which lie in ruins throughout the southwestern part of the United States.

A thoroughly equipped expedition, the entire expenses of which were paid by Mrs. Hemenway, who had become interested in Mr. Cushing's project, started for Arizona in 1887. For three years a most thorough, careful and scientifically conducted expedition was carried on among these pueblos under the direction of Mr. Cushing.

The collection of specimens, including almost every variety of prehistoric implement, utensil and ornament in use among the ancient dwellers, which Mr. Cushing obtained is the most valuable ever carried out of Arizona. There is nothing from the same region comparable to it anywhere. Even more valuable are the facts which Mr. Cushing was enabled to learn from his explorations about the life and religious habits of this heretofore mysterious race. As yet, however, the facts have not been published by Mr. Cushing, who, since his illness, has been employed by the national government.

The explorations of Dr. Fewkes were made during the summers of 1890, 1891, 1892 and 1893. They were confined exclusively to the Moqui and Zuñi tribes.

Much attention was paid to the religious ceremonies of the Zuñis. A set of phonograph cylinders, recording their religious songs, was obtained during the summer of 1890. The cylinders, of course, are preserved in the Hemenway collection.

A year or so later the magnificent Keam collection was acquired by purchase. Keam had been a trader among the Moqui Indians for twenty years. Like most Indian traders, he had acquired a collection of utensils and religious paraphernalia, collected with an idea to sell at some future day. He had refused to sell single pieces, keeping the whole lot intact for some future purchaser. Every specimen was labeled with a short description. In its numbers are included both ancient and modern articles—blankets, basket ware, religious and household pottery, kilts, dolls (which are made in the likeness of idols, serving as a sort of kindergarten instruction to the children in religion), in fact, almost every type of old and new, of everything in use among the Moquis and their predecessors. Not only is the collection the best in the world, but it must always remain so, for the Moquis have by this time become sophisticated by white civilization. Added to this Keam collection are the valuable supplementary collections gathered by the Hemenway expedition itself.

Thirty-five hundred specimens were beautifully arranged in the exhibition held two years ago in Madrid to commemorate the four hundredth anniversary of the discovery of America. These specimens were intended to illustrate the habits of the natives of New Mexico at the time of the landing of Columbus. They gained Mrs. Hemenway a personal letter of thanks from the Queen of Spain, and their curator the decoration of the Order of Isabella the Catholic.

MICROSCOPY.[1]

New Method of Imbedding in a Mixture of Celloidin and Paraffine.[2]—Messrs. Field and Martin recommend the following method as an improvement on those proposed a few years ago by Ryder and Kultschizky. The method permits of imbedding the object directly in a mixture of celloidin and paraffine. The mixture is prepared by using as a solvent, alcohol and toluol (toluène); the latter, taking the place of ether, makes it possible to dissolve paraffine in the celloidin solution. Proceed as follows:

1. Make a mixture of absolute alcohol and toluol in equal parts.

2. Soak some dry celloidin in toluol; after some hours, add a little of the alcohol-toluol.[3] The celloidin swells up and dissolves. The solution should have about the consistency of clove oil.

3. Finally, add to this mixture some shavings of paraffine, obtained by scraping the surface of a block of this substance with a scalpel. In order to hasten the solution and increase the proportion of paraffine the mixture may be heated a little. Above 20° to 23°, one runs the risk of precipitating the celloidin, which separates in a transparent granular mass.

These mixtures prepared, the process of imbedding is executed in the following manner: The object, taken from absolute alcohol, is placed in the alcohol-toluol. It is easily and quickly saturated, and is then placed directly in the imbedding mixture. The penetration is more rapid than in the ordinary celloidin solution. As soon as saturation is complete, one may proceed to solidify the celloidin. This may be done in two ways:

1. The object is transferred to a saturated solution of paraffine in chloroform, and when the solidification is complete (2–3ds.), the imbedding paraffine is carried out according to the well known method Bütschli.

[1]Ed. By Prof. C. O. Whitman, University of Chicago.

[2]Bull Soc. Zool de France, XIX, p. 48, Mar. 13, 1894, and Zeitschr. f. wiss. Mikr., XI, 1, 1894.

[3]The alcohol-toluol is added after the tuluol has been turned off. About 45cc is enough for 1 grm. of celloidin. This solution will dissolve about ½ grm. of paraffine (melting at 56°) at ordinary room temperature.

2. The object is placed in toluol containing some paraffine in solution. The alcohol diffuses in the excess of toluol, and the celloidin solidifies. Imbed as before.

In both cases care must be taken to avoid shrinkage, which occurs if the celloidin is solidified in pure paraffine.

The object thus imbedded in paraffine is sectioned in the usual way. The ribbons of sections are fixed to the slide by means of the ordinary albumen fixative, or by the aid of pure water. In the latter case, the strips cut to the length desired are placed on a clean slide slightly wet with water. Then a little water is added by means of a brush, just enough to barely float the sections[4] The slide is then heated so as to soften the paraffine without melting it. The sections expand readily. It remains only to drain off the water and let the slide dry completely.

If desired the celloidin may be removed by the mixture of alcohol and toluol which dissolves at once both the paraffine and celloidin. Then, after washing with toluol, the sections may be mounted in balsam in the usual way. If they are to be colored on the slide, they should be washed with alcohol and water.

On the Fixing of Paraffine Sections to the Slide.—A combination of the water method of Suchannek and Heidenhain with the albumen method of Mayer has been found very useful as it does away with the slow-drying of the former method and still permits the ready arrangement of the sections and their expansion and flattening.

A slide, cleaned with only ordinary care, is covered by means of the finger with the least possible amount of Mayer's Albumen. By means of a small brush the upper surface of the slide is then flooded with water and the brush, still slightly wet, is used for picking up and arranging the sections or ribbons. The brush may then be used for removing the excess of water, and the slide slightly warmed for a few moments on a water-bottle, care being taken that the sections do not melt. The sections soon expand and float upon the water which should be drained away and slide placed a second time upon the water-bath. After remaining about fifteen minutes the paraffine may be melted and the slide plunged into turpentine or some other solvent of paraffine.—H. C. Bumpus, Marine Biological Laboratory, Woods Holl, Mass.

[4]The following note by Dr. Bumpus suggests an improvement.

SCIENTIFIC NEWS.

The work of the Michigan Fish Commission in 1894.—After a careful study of various points along the coast, Charlevoix has finally been decided upon as the location for the work of this year. It lies on the eastern shore of Lake Michigan just north of Grand Traverse Bay, within easy reach of numerous white fish spawning and fishing grounds. Extensive fishing operations are carried on here throughout the year, and varied conditions of shore and bottom are to be found within easy reach. Opposite this point Lake Michigan reaches a depth of 850 feet, and shallow water with reefs and islands are not far distant. Numerous inland lakes of varying size are also readily accessible and the variety of conditions is unsurpassed by any point on this shore. In addition to this the Commission has already at Charlevoix a hatchery which will furnish extensive aquaria for keeping specimens alive and for experimental work. A carpenter shop next door to the hatchery building has been rented for the summer and fitted out as a laboratory, with tables, shelves, reagents and the necessary apparatus. The University of Michigan co-operates with the undertaking as in former years, and has renewed its loan of apparatus and of a special library. Several boats, including a small steamer and all kinds of nets for shallow and deep water work and for bottom and surface collecting, are at the service of the party.

The work will include a determination of the fauna and flora of Lake Michigan at this point and of their vertical and horizontal distribution. This determination will be both qualitative and quantitative, and will be particularly directed towards a study of the life history of the white fish and lake trout. Since the life of the water constitutes, first or last, the food of the fish in it, this determination will afford some idea of the value of this locality as a breeding ground for fish and of its adaptability as a planting ground for the fry. The temperature, transparency and purity of the water and the character of shore and bottom, as well as the currents and connecting lakes will receive attention as problems which affect most powerfully the welfare of the fish.

The party at work in the laboratory will consist of Professor Henry B. Ward, University of Nebraska, Director; Professor E. A. Birge, University of Wisconsin; Professor C. Dwight Marsh, Ripon College, Wisconsin; Dr. Charles A. Kofoid, University of Michigan; Dr. Robert H. Walcott, University of Michigan; Mr. Herbert S. Jennings, University of Michigan; Mr. Bryant Walker, Detroit, Michigan. In addition to these, a number of specialists will be guests of the Commission for a longer or shorter interval.

The laboratory will be open during July and August, and visiting scientists will be accorded a most cordial welcome. To a certain extent it will be possible to offer the privileges of the laboratory to specialists who may wish to carry on investigations on special groups. Notice of such cases should be sent to the director as early as possible, that the necessary arragements may be made.

The Biological Station of the University of Illinois.— The field operations and the resources of the natural history departments of the University, especially those of zoology and botany, have been notably increased during the last term by the establishment, April 1, on the Illinois River, at Havana, of a biological station devoted to the systematic and continuous investigation of the plant and animal life of the waters of that region. This establishment, authorized by the trustees of the University at their March meeting, is under the direction of Professor Forbes, with Mr. Frank Smith, assistant in zoology, in immediate charge of the work. Mr. Adolph Hempel and Mrs. Smith also work there continuously, with an expert fisherman as factotum.

The field work is now done from a cabin boat, chartered for the summer, which carries the seines, dredges, surface nets, plankton apparatus, and other collecting equipment, together with microscopes, reagents for the preservation of specimens, a small working library, a number of special breeding cages for aquatic insects, and a few aquaria. This boat is provided with sleeping accommodations for four men, and with a well-furnished kitchen.

In Havana itself are office and laboratory rooms supplied with running water and electric light, and provided with the usual equipment of a biological laboratory, consisting of first-class microscopes, microtomes, biological reagents, etc., and tables for five assistants. Professor Forbes and Mr. Hart, of the state laboratory of natural history, visit the station frequently for special lines of work.

The boat is established in Quiver Lake, an elongate bay or Illinois, two and a half miles above Havana. At low water this lake is about two miles long with a steep sandy bank some fifty feet high on the eastern side and a mud flat on the western. The banks are wooded, on the east mostly with oak and hickory, and on the west with the lowland species. The locality is beautiful and healthful, and the water excellent.

From the lake and the river selection has been made of a number ot typical situations, and from these, and from Phelps and Thompson Lakes a little distance away, collections of all descriptions are made at regular intervals for a comparative study of the organic life—the relative abundance of the species at different seasons of the year, and the general system of conditions by which it is affected.

The plan of operation contemplates continuous work at this station for several years, with especial reference to the effect of the enormous overflow and rapid retreat of waters characteristic of the Illinois and the Mississippi system generally. Continuous studies are made of the food of all the species collected, with final reference to the feeding habits and food resources of the native fishes of the region. Temperatures are taken daily, and analyses of the waters of the lake and river at the various stations are being made at regular intervals by the chemical department of the University.

This station will be held open for graduate students in zoology and botany wishing to take their advanced degrees in zoological or botanical lines. Such students, choosing to pursue their studies at Havana will be furnished with every facility for the original investigation of a large variety of subjects, and arrangements will be made by which the other studies of their postgraduate courses may be carried forward without embarrassment.

The station is further capable of sufficient expansion to accommodate other investigators from the University and from the University summer school, for whose benefit excursions will be arranged as may be found profitable.

This is the first inland aquatic biological station in America manned and equipped for continuous investigation ; and the first in the world to undertake the serious study of the biology of a river system.—*From the Illini, June* 6, 1894.

Cook's Excursion to Greenland.—The excursion to visit Greenland organized by Dr. Frederick A. Cook, anthropologist of Peary's first expedition, consists of fifty persons, of whom a good part are students of science. They have chartered the steamer Miranda and will sail directly for the far north, stopping at Cape Breton, and at two or three places in Labrador and Southern Greenland, reaching Inglefield Gulf about the first of August. Among the scientific members are Professor W. H. Brewer of Yale College, who will go the whole round ; Professor B. C. Jillson of Pittsburg, Pa., who with Professor G. F. Wright and son, of Oberlin, O., and a party of six, will stop off in Umenak Fiord about latitude 71, to study the border of the ice sheet, the neighboring glacial deposits, the glaciers entering the fiord, the Tertiary deposits of the vicinity, and make a collection of the plants and animals.

Professor L. L. Dyche, at the head of the department of Zoology and Taxidermy at the State University of Kansas, is the official naturalist of the expedition, and will go the full round. He will make a specialty of collecting Birds and Mammals. He will have under him Mr. S. P. Orth of Oberlin, O., botanist, and B. F. Stanton of Oberlin, assistant naturalist, to make general collections. Mr. E. A. McIlhenney of Louisana, goes as an ornithologist.

Professer C. E. Hite of Philadelphia with three assistants is to stop off in Labrador for general exploration. Professor E. P. Lyon of Chicago goes for the general student of biology. The expedition expects to return about September 20th.—G. F. Wright.

The Forty-third Meeting of the American Association for the Advancement of Science, will he held in Brooklyn, New York, August 15 to 24, 1894. The following officers will be in charge:

President, Daniel G. Brinton, Media, Pa.

Vice-Presidents, A.—Mathametics and Astronomy, George C. Comstock, Madison, Wis.; B.—Physics, Wm. A. Rogers, Waterville, Me.; C.—Chemistry, T. H. Norton, Cincinnati, O.; D.—Mechanical Science and Engineering, Mansfield Merriman, South Bethlehem, Pa.; E.—Geology and Geography, Samuel Calvin, Iowa City, Iowa; F.—Zoology, S. H. Scudder, Cambridge, Mass. (Resigned); G.—Botany, L. M. Underwood, Greencastle, Ind.; H.—Anthropology, Franz Boaz, New York; I.—Economic Science and Statistics, Henry Farquhar, Washington, D. C.

Permanent Secretary, F. W. Putnam, Cambridge (office, Salem), Mass.

General Secretary, H. L. Fairchild, Rochester, N. Y.

Secretary of the Council, James Lewis Howe, Louisville, Ky.

Dr. August von Klipstein, formerly Professor of Mineralogy at Giesson, died, April 16, 1894, in his 93d year.

The news of the appointment of Sidney J. Heckson of Downing College, Cambridge, to the Chair of Zoology at Owens College, Manchester, will prove welcome to his many friends.

Science in Persia! The Shah has instituted a zoological garden.

Dr. Joseph Hyrtl, the anatomist, died, July 17, 1894. He was born on Dec. 7, 1811, at Eisenstadt, Hungary, and studied at Vienna, where he obtained, at the age of twenty-one, the position of preparator. He was chosen in 1837 as professor in the University of Prague, and in 1845 returned to Vienna as professor of anatomy at the university there. In 1857 he became a member of the Imperial Academy of Sciences. He was one of Austria's most distinguished anatomists and the author of two works which have come to be accepted as standard authorities throughont the world—"The Manual of Physiological and Practical Anatomy" and "The Manual of Topographical Anatomy and Its Applications." Dr. Hyrtl, being very skilful in the art of preparing anatomical specimens, established in Vienna an anatomical museum, of which he published a most interesting description. He had enriched most of the anatomical collections of Europe with models of rare perfection. One of his collections, that of the skeletons of fishes, was purchased by Prof. Cope of Philadelphia. He was for a time director of the Ecole Superieure, resigning the position in 1874.

Dr. George Huntington Williams, professor of geology at Johns Hopkins University, whose death occurred in July, founded the department of mineralogy and geology at the Johns Hopkins in 1883, and since that time had acquired a wide reputation among scientific men for his intimate knowledge of the geology and topography of Maryland. He was also a collaborator of the United States Geological Survey, and prepared a number of special reports for the survey during his summer vacation. He was born Jan. 28, 1856, at Utica, N. Y. His connection with the Johns Hopkins dates from March, 1883, when he entered the university as a fellow by courtesy. In October of that year he was added to the faculty as an associate in mineralogy. In 1885 he was made an associate professor, and in 1892 was chosen to the chair of inorganic geology. His writings include nearly a hundred geological and mineralogical papers in scientific journals, more than one-half of which treat of the geology of Maryland, especially in the vicinity of Baltimore. He wrote "The Elements of Crystallography," and had been engaged for a number of years in preparing a new geological map of Maryland for the United States Geological Survey. He was one of the judges of the mines and mining exhibit at the World's Fair, an editor of the Standard Dictionary, recently issued, and of Johnson's Cyclopedia, now in press. He was a member of the National Academy of Sciences, a vice-president of the Geological Society of America, and a member of the American Institute of Mining Engineers, the Washington Geological Society and other scientific bodies.

Johannes Nill, founder of the Stuttgart Zoological Garden. died in that city May 20, 1894; his son, Adolf Nill, is his successor in the management of the garden.

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ON THE ORIGIN OF THE SUBTERRANEAN FAUNA OF NORTH AMERICA.

BY ALPHEUS S. PACKARD.[1]

Having, in my essay on the Cave Fauna of this continent, attempted to bring together as many facts as possible bearing on this subject, in now addressing the members of this Congress on the topic assigned me, it will be well to first give a *résumé* of the general subject and then to call attention to the additional facts and conclusions relating to this interesting topic.

In that work I took the view that the cave fauna of this country, and presumably of the world in general, was formed of emigrants or colonists from the surrounding regions of the upper world. I may be permitted to give an extract from what I published in 1888, in order to call attention to the scope of the inquiry.

"The conditions of existence in caverns, subterraneous streams and deep wells, are so marked and unlike those which environ the great majority of organisms, that their effects on the animals which have been able to adapt themselves to such conditions at once arrest the attention of the observer. To such facts as are afforded by cave-life, as well as parasitism, the philosophic biologist naturally first turns for the basis of

[1] Read at the meeting of the Zoological Congress of the World's Auxiliary Congress of the Columbian Exposition, Chicago, 1894.

his inductions and deductions as to the use and disuse of organs in inducing their atrophy. It is comparatively easy to trace the effects of absence of light on animals belonging to genera, families, or orders in which eyes are normally almost universally present. As we have seen in the list already given of non-cavernicolous animals, the eyes are wanting from causes of the same nature as have induced their absence in true cave animals. No animal or series of generations of animals, wholly or in part, loses the organs of vision unless there is a physical, appreciable cause for it. While we may never be able to satisfactorily explain the loss of eyes in certain deep-sea animals from our inability to personally penetrate to the abysses of the sea, we can explore caves at all times of day and night, of winter and summer; we can study the egg-laying habits of the animals, and their embryonic development; we can readily understand how the caves were colonized from the animals living in their vicinity; we can nicely estimate the nature of their food, and its source and amount, as compared with that accessible to out-of-door animals; we can estimate with some approach to exactitude the length of time which has elapsed since the caves were abandoned by the subterranean streams which formed them and became fitted for the abode of animal life. The caves in Southern Europe have been explored by more numerous observers than those of this country, and the European cave fauna is richer than the American, but the conditions of European cave-life and the effects of absence of light and the geological age of the cave fauna are a nearly exact parallel with those presented in the pages of my memoir. Moreover, the cave-life of New Zealand and the forms there living in subterranean passages and in wells, show that animal life in that region of the earth has been affected in the same manner. The facts seem to point to the origin of the cave forms from the species now constituting a portion of the present Plistocene fauna; hence they are of very recent origin."

The advances in our knowledge of cave-life made since 1886 and 1887, may be referred to under the following heads:

I. The fauna of caves, subterranean waters and wells, and their origin, investigated by H. Garman, Herrerao, Girard, Bolivar, Cope and Stejneger.

II. New facts regarding blind non-cavernicolous or lucifugous forms, comprising the anatomical and physiological investigations of Eigenmann, Hess, Kadyi, Schlampf, Ritter, and others.

III. Embryological observations on the conditions of the eyes in the young or in the embryos, tending to prove the origin of blind forms from normal eyed ancestors, by Teller and by Eigenmann.

IV. Theoretical discussions, by Weismann, Herbert Spencer, Lankester, and others.

I. It is very desirable to make a thorough survey of the animal life living at present in the region around the entrances of caves, in order to ascertain the eyed forms from which the blind ones may have originated. This Professor Garman has begun to do for the cave-region of Kentucky. In his article in "Science," on the origin of the cave-fauna of Kentucky," while he remarks that "the geological evidence is all that could be desired for proof of a recent origin of the caves themselves," he dissents "from the conclusions which have been drawn from this proof, as to the recent origin of the blind animals," claiming that animals which burrow in the soil everywhere show a tendency to loss of the organs of vision," and that "the originals of the cave species of Kentucky were probably already adjusted to a life in the earth before the caves were formed," and adds, "I cannot believe that there has been anything more than a gradual assembling in the caves of animals adapted to a life in such channels. In this view of the matter the transformation of eyed into eyeless species appears to have been much less sudden and recent than has been supposed." He illustrates his point by the "definite example of the blind crustacean, *Caecidotaea* (Asellus) *stygia,* which, though first discovered in caves, is also widely distributed in the upper Mississippi Valley, occurring as far east as Pennsylvania. "It is, throughout its range, a creature of underground streams, and is nowhere more common than on the prairies of Illinois (the last place in the country in which one would expect to find a cave), where it may be collected literally by the hundreds at the mouths of the tile-drains and in springs. In Kentucky also it is not more abundant in the cave region than elsewhere, being very frequently common under rocks in springs and in streams flowing from them, even during its breeding season. It is only natural that such a crustacean should have found itself at home in Mammoth Cave when this cave was ready for its reception."

"I scarcely see what grounds there are for supposing that the present cave species are older than the remaining Quaternary fauna. All the blind and eyeless or partially eyed species must, in the beginning, have descended from normally-eyed forms, while the loss of vision or the disappearance of eyes, even where the rudiments of eyes remain, may, in some cases, have been comparatively sudden (by which we mean after several generations, or less, say, than a hundred), or in others have required hundreds of generations. In some cases, as in that of *Caecidotaea*, forms living in subterranean streams or under stones or buried in the soil, may have become already modified before being carried, or before migrating into the caves."

Mr. Garman then refers to the blind fishes, giving some new facts regarding their distribution. Finally he writes of the distribution of the blind beetles of the genus Anophthalmus, and gives an interesting account of a new species (*A. hornii*) discovered in fissures in the Trenton limestone of Lexington, Ky. This is an interesting example of the way in which a species living in conditions intermediate between an out-of-door life under stones or in the soil and in caves, becomes gradually adapted to a cavernicolous existence. The author also states his belief "that there appears to have been, after the Champlain period, a migration towards Mammoth Cave of cave insects from the south and east, when the continent had not been so greatly affected by changes of level as was the Mississippi Valley. Mr. Garman also sees nothing to indicate that cave animals have ever been more completely isolated than they are now, a view with which we agree. This does not conflict with the general view we have expressed that isolation is an important factor in the evolution of the fauna of caves, of subterranean waters, and of other dark situations.

Other additions to our subterranean fauna have been noticed by Mr. S. Garman, who finds in the caves of southwestern Missouri, in which are subterranean streams, besides *Tiphlichthys subterraneus* Girard a new species of blind crayfish (*Cambarus setosus* Faxon); what "seems" to be *Ceuthophilus sloanii* Pack. and *Asellus hoppiae* Garman, "from Day's Cave, in mud under stones;" the latter form seems to be a genuine, eyed *Asellus*, and allied to an undetermined species represented on Pl. IV, fig. of our memoir, collected from a brook near Lancaster, Ky. The six other species of invertebrates mentioned belong to common out-of-door species, including a dragon-fly, a Dineutes, and a Hydrotrechus, and need not have been mentioned in connection with cave insects, as multitudes of insects naturally occur at or near the mouth of caves.

Here might be mentioned the interesting discovery by Mr. Nathan Banks of the common Phalangid of Wyandotte Cave, *Scotolemon flavescens* Cope, "under stones on the Virginia shore of the Potomac near Washington, D. C.," which, he says, "does not differ from cave specimens."[2]

A blind Salamander has also been discovered in this country by Mr. Stejneger. In the Rock House Cave, Missouri, on the walls, about 600 feet from the entrance, occurred a blind salamander (*Typhlotriton spelaeus*), forming a new genus and species of the family Desmognathidae. In the single adult captured the eyes are said to be "concealed under the continuous skin of the head." A larva was found, but, strangely enough, the condition of the eyes in the young is not referred to.

Passing out of our territory into Mexico, Professor Alfonso L. Herrera describes the results of his researches on the fauna of Cacahuamilpa Grotto, in Mexico. The new or more interesting forms are the following:

[2] The Phalangida Mecostethi of the United States. Trans. Amer. Ent. Soc., XX, 149-152. June, 1893.

Insects.

Choleva cacahuamilpensis (Ch. spelaea Bilmk.).
Tachys cacahuamilpensis (Bembidium unistriatum Bilmk.).
Ornix cacahuamilpensis (Ornix impressipenella Bilmk.).
Pholeomyia cacahuamilpensis Herrera.
Phalangopsis cacahuamilpensis Herrera (Ph. annulata Bilmk.).
Lepisma cacahuamilpensis Herrera (L. anophthalma Bilmk.).

Arachnida.

Phrynus cacahuamilpensis Herrera (Ph. mexicanus Bilmk.).
Drassus cacahuamilpensis Herrera (D. pallidipalpis Bilmk.).
Nesticus cacahuamilpensis Herrera (Pholcus cordatus Bilmk.).

Myriopoda.

Scutigera cacahuamilpensis Herrera.

Crustacea.

Armadillo cacahuamilpensis Bilmk.

I have received from Professor Herrera an eyeless Asellid crustacean taken from a well at Montery, Leon, Mexico. It shows no traces of eyes, and apparently belongs to a new genus, the species also being undescribed.

II. New Facts Regarding Blind, Non-cavernicolous, or Lucifugous Forms.

Although not a cave-dweller, the blind goby of the Californian coast lives in similar conditions and tells the same story as the blind Proteus of the cave of Adelsberg or the blind salamander of the Missouri Cave, of the loss of eyesight by disease. The blind goby (*Typhlogobius californiensis* Steindachner) occurs abundantly at Point Loma, San Diego, under rocks between tide-marks in holes made by "crabs" (more properly, shrimps). As Professor C. H. Eigenmann tells us, in his paper on the "Fishes of San Diego:" "It has been found nowhere else about San Diego, but has been taken at Ensenada. Its habitat is, as far as known, quite limited. In its pink color and general appearance it much resembles the blind fishes inhabiting the caves of southern Indiana. Its peculiarities are doubtless due to its habits. The entire bay region is inhabited by a carideoid crustacean which burrows in the mud. It, like the blind fish, is pink in color. Its holes in the bay are frequented by Cleavelandia, etc., while at the base of Point Loma, where the waves sometimes dash with great force, the blind fish is its associate. . . . . In the bay the gobies habitually live out of the holes, into which they descend only when they are frightened, while at Point Loma this species never leaves its subterranean abode, and to this fact we must attribute its present condition.

"How long these fishes have lived after their present fashion it would be hard to conjecture. The period which would produce such decided structural changes can not be a brief one. The scales have entirely disappeared, the color has been reduced, the spinous dorsal has been greatly reduced ; not only have the eyes become stunted, but the whole frontal region of the skull, and the optic nerves have been profoundly changed.

"The skin, and especially that of the head, has become highly sensitized. The skin of the snout is variously folded and puckered and well-supplied with nerves; the nares are situated at the end of a fleshy protuberance which projects well forward, just over the mouth. At the chin are various short tentacles, and a row of papillae, which very probably bear sensory hairs similar to those represented in Figs. 15 and 16 (Plate XXIII), extends along each ramus of the lower jaw, and along the margin of the lower limb of the preopercle. The eye is, however, the part most seriously affected. In the young, Fig. 7, it is quite evident, and is apparently functional. Objects thrust in front of them are always perceived, but the field of vision is quite limited. With age, the skin over the eye thickens, and the eyes are scarcely evident externally. As far as I could determine, they do not see at this time, and certainly detect their food chiefly, if not altogether, by the sense of touch. A hungry individual will swim over meats, fish or a mussel, etc., intended for its food without perceiving it by sight or smell, but as soon as the food comes in contact with any portion of the skin, especially of the head region, the sluggish movements are instantly transformed, and a stroke of the fins brings the mouth immediately in position for operations."

Here, again, it may be observed that this blind fish is probably not older than the beginning of the Plistocene period, since we know that the coast of California has been rising since the Pliocene epoch, and therefore the coast lines have materially changed since the end of the Tertiary.

For a very full and elaborate account of the degenerate eyes of this blind fish we are indebted to Mr. W. E. Ritter, in an essay published during the present year. Besides the eyes he treats histologically of the integumentary sense papillae, and of the integument of this animal, giving a summary of his results on pp. 96 and 97, which we in part reproduce.

1. In the smallest examples of the blind goby studied, the eyes, though very small, are distinctly visible even in preserved specimens, the lens being plainly seen. In the largest specimens, on the other hand, they are so deeply buried in the tissue as to appear even in the living animals as mere black specks, while in preserved ones they are, in many cases, wholly invisible.

2. As is the case with rudimentary organs in general, the eye is subject to great individual variation in size, form, and degree of differentiation.

3. The only parts of the normal teleostean eye of which no traces have been found are the *argentea*, the *lamina suprachoroidea*, the *processus falciformis*, the cones of the retina, the vitreous body proper, the lens capsule, and, in one specimen, the lens itself.

4. In the parts present the rudimentary condition of the organ is seen in the very slight development of the choroid; in the fact that the choroid gland is composed entirely of pigment; in the fact that the iris, though of fully the normal thickness, is almost entirely composed of pigment; with great proportional thickness of the pigment layer of the retina and the entire absence in it of anything excepting pigment; in the minute size of the optic nerve, and finally in the small size of the *motores oculi*.

5. The surest evidences of actual degeneration are found, first, in the greatly increased quantity of pigment, and secondly, in the presence of pigment in regions where none is found in the normal eye, as in the hyaloid membrane.

6. On comparing the eyes of all blind vertebrates that have been most carefully studied, all may, in a general way, be said to be passing along the same degenerative path.

7. The eyes of blind vertebrates furnish very little evidence on the question whether structures in undergoing actual degeneration in ontogeny follow the reverse order of their phylogeny.

Ritter also states that from the works of European authors it is possible to make a detailed comparison of the eyes of Typhlogobius with those of *Proteus anguinus* and of the European mole, which he proceeds to do. On the whole, the eye of Proteus is more rudimentary than that of either Typhlogobius or Talpa, the lens being absent in the cave Amphibians. All authors, except Semper, are agreed that the optic nerve is present in both Proteus and Talpa, but Ritter finds no account of it ever having, in either of these animals, a pigment-sheath in its passage through the retina, such as occurs in Typhlogobius.

III. Embryological Observations on the Condition of the Eyes in the Embryo or in the Young, proving the Origin of the blind or eyeless Forms from normally-eyed Ancestors.

No complete observations have, so far as we are aware, been made on the embryology of cave animals, nor on that of eyeless non-cavernicolous forms, except in the few cases which we proceed to mention. In our essay on the Cave Fauna of North America (p. 139), we record the fact that in the young of the blind crayfish (*Orconectes pellucidus*), the eyes of the young are perceptibly larger in proportion to the rest of the body than in the adult, the young specimen observed being about half an inch in length. Previously to this, Dr. Tellkampf, in 1844, remarked that "the eyes are rudimentary in the adults, but are larger in the young." Mr. S. Garman states, regarding the blind Cambarus of the Missouri Cave: "Very young specimens of *C. setosus* correspond better with the adults of *C. bartonii;* their eyes are more prominent in these stages, and appear to lack but the pigment." In the blind cave-shrimp (Troglocaris) of Austria, Dr. Joseph discovered that the embryo is provided in the egg with eyes.

In this connection should be recalled the observations of Semper in his Animal Life (p. 80, 81) on *Pinnotheres holothuriae,* which lives in the "water-lungs" of Holothurians, where, of course, there is an absence of light. The zoëa of this form has large, "well-developed eyes of the typical character. Even when they enter the animal, they still preserve these eyes; but as they grow they gradually become blind or half-blind, the brow grows forward over the eyes, and finally covers them so completely that, in the oldest individuals, not the slightest trace of them, or of the pigment, is to be seen through the thick skin, while, at the same time, the eyes seem to undergo a more or less extensive retrogressive metamorphosis."

In this connection may be mentioned the case of the burrowing blind shrimp (*Callianassa stimpsonii*) which has been found by Professor H. C. Bumpus, at Wood's Holl, Mass., living in holes at a depth of between one and two feet. He has kindly given me a specimen of the shrimp, which is blind, with reduced eyes, smaller in proportion to the body than those of the blind crayfish. He has also obtained the eggs, and has found that the embryos are provided with distinct, black, pigmented eyes, which can be seen through the egg-shell.

Recently, Zeller has studied the embryology of the Proteus of Adelsberg Cave, and has confirmed the statement of Michahelles, who, in 1831, discovered that the eyes of this animal are more distinct in the young and somewhat larger than in the adult. We quote and translate from Zeller's acccount:

"The development of the eyes is very remarkable; they are immediately perceived and present themselves as small, but entirely black and clearly drawn circular points with a slit which is very narrow and yet, at the same time, well-defined, and which penetrates from the lower circumference out to the middle.

"Indeed, one can hardly doubt that this astonishing development of the eye has been accomplished by the influence of light as has also the pigmentation of the skin, the reddish-white ground color of which appears thickly studded with very small brownish-gray points mixed with detached white ones, over the upper surface of the head and over the back down over the sides of the yellowish abdomen. Even on the edge of the fins (Flossensaum) the pigment is found. On the other hand there is a whitish spot over the snout as is likewise the case in the adult creatures which have been colored by the light. Both the under surface of the head and the entire abdomen are shown free from pigment like the limbs. . . . .

"I cannot specify very exactly as to when the pigmentation of the skin begins, but, in any case, it is very early and often earlier that the first beginning of the eyes can be discovered. The latter occurs toward the end of the twelfth week, at which time a thin, light gray line, which still appears overgrown, may be perceived, forming a half circle open underneath. Then while this line subsequently becomes clearer and darker and its ends grow further under and towards each other, there also takes place simultaneously a progression of the pigment larger towards the middle point, and the circle finally seems closed and filled up to the narrow slit mentioned above, which proceeds from the lower circumference and penetrates to the middle of the eye." (p. 570, 571.)

But the most striking discovery bearing on this subject is that of the condition of the eyes in the embryo and young compared with the adult of the blind goby of San Diego.

In his essay on the Fishes of San Diego, Professor Eigenmann briefly refers to and gives four figures (Pl. XXIV) of the embryo of Typhlogobius, Mr. C. L. Bragg having been fortunate enough to discover the egg in the summer of 1891. "The eyes develop normally, and those of Fig. 4 differ in no way from the eyes of other fish embryos." In this case, then, we have the simplest and clearest possible proof of the descent of this blind fish from individuals with eyes as perfect as those of its congeners.

We have been permitted by the Director of the United States National Museum to reproduce Professor Eigenmann's excellent figures on the embryo, which tell the story of degeneration of the eye from simple disease of the organ, the species being exposed to conditions of life strikingly different from those of its family living in the same bay.

Before the discovery of the eggs, the youngest individual ever seen is represented in Pl. XXIII, fig. 7, its eyes being though small, yet distinct, and "apparently functional."

From these data it is obvious that future embryological study on cave animals will farther demonstrate their origin from ancestors with normal eyes.

IV. Theoretical Results bearing on the Theory of Descent, and more especially on the Neolamarckian Phase of the Theory, including the Doctrine of the Transmission of acquired Characters.

It is evident that the cases just cited afford the strongest possible proof of the theory of evolution in general, and do not militate against the truth of the Neolamarckian phase of the theory, which holds that by a change of environment, inducing disuse of the eyes, such variations, especially atrophy of a part or whole of the eyes and optic nerves and ganglia have become established, so as to result in the origin of new species and even new genera.

In the case of the blind goby, the burrowing Callianassa, the blind shrimp of Adelsberg Cave, and, in fact, nearly, if not quite all the blind forms now known, it is easy to see that the causes of variation are quite direct and appreciable, and that we do not need to invoke the principle of natural selection. And this is the view of Darwin himself.[3]

Besides the factors of change of environment and of disuse, the influence of the isolation of these forms from their out-of-doors' allies should not be overlooked. Take the case of the blind goby of San Diego Bay, or the Callianassa of Buzzard's Bay. Living in habitats remote from their congeners, obvi-

[3] In our work on the Cave Fauna of North America we have discussed the bearing of the facts of cave-life on the Darwinian and Lamarckian phases of evolution and have attempted to show that natural selection is inoperative in such cases as these, quoting Darwin's own words when referring to the loss of eyes in such animals: "I attribute their loss wholly to disuse" (p. 137–143).

ously as soon as their ancestors took up a burrowing mode of life, they were prevented from crossing with others of their species, and, probably, when in sporadic cases it did occur, very soon the swamping effects of intercrossing wholly ceased, only those in which the eyes had begun to degenerate interbreeding. After a few generations, therefore, owing to this isolation, the partially blind forms became fixed by heredity and by the very force of circumstances a blind or eyeless generation resulted.

These circumstances are paralled by the results of the intermarriage of deaf-mutes. Professor A. Graham Bell[4] has pointed out the danger of the establishment of a distinct variety of deaf-mutes with a special sign language of their own, since owing to their peculiar social environment and isolation in society there has lately arisen a strong tendency of deaf mutes to intermarry. The result, so far as gathered from a tolerably wide range of facts, shows that this incipient deaf mute strain or variety may have originated in two generations, since it seems probable, as Mr. Bell remarks, "that the oldest deaf mute in the country whose parents were both deaf mutes is now only a little past middle age."

Moreover, the cases we have cited tend to show that the origination of new species and genera of subterranean, as well as deep sea forms and others living in darkness, may have been induced after comparatively few generations. Future observations should be directed to this point. The moment that several individuals became isolated in dark holes or in caves, and more or less confined in such narrow limits, the effects of darkness would at once begin to be experienced, and some degree of adaptation to their changed conditions would immediately begin to operate. The individuals of this generation, i, e., the new comers in the cave, or those gobies which by burrowing in the mud had penetrated out of reach of their

[4] On the formation of a deaf variety of the human race. Memoirs National Academy of Sciences for 1883, Washington, ii, 179–262, 1884. The author points out the means of isolation of deaf mutes through asylums and national, state and city associations for promoting social intercourse, often resulting in intermarriages. He also gives "specimen cases to prove that in many different parts of the country deafness has been transmitted by heredity." (p. 210).

congeners, would doubtless become used to life in darkness. Their offspring of the first generation might or might not suffer some alteration in the visual organs, but doubtless some slight degree of physiological change would result; this might or might not be latent in the next generation, or it might crop out and become manifested in the first generation, or, if not in the first, in the second or third. As soon as the degeneration in the eye-sight began to become fixed by heredity, the process must have gone on rapidly, and, in a few generations, perhaps a dozen or twenty, or fifty, rather than many hundreds or thousands, or "numberless generations," as most writers since Darwin claim.

Now as deaf mutes already appear to breed true to their incipient strain or variety, whether congenitally deaf or rendered so by disease during the lifetime of either or both parents, it seems most probable that animals not at first congenitally blind, might have acquired, after having been carried into, and after living for some months or even years in darkness, the tendency to blindness, and have transmitted to their offspring such first steps in adaptation to their Cimmerian environment. It is difficult for any one, it seems to us, not hidebound by theory to imagine any other mode of procedure.

The steps in the process are these: 1, The change in environment from normal conditions to partial or total darkness; 2, At first a slight degree of adaptation to such change, if the animal survived at all; 3, Becoming gradually habituated to the darkness, compensation for the loss of eyesight would result in the stimulation of the senses of touch and smell; 4, Meanwhile the physiological change from loss of eyesight would react on the physical structure and the eye would begin to degenerate, and very rapidly, after a few generations, the optic nerves in some forms, or the optic lobes and nerves in others, would disappear, the vestiges of the outer structures of the eyes remaining in some forms long after the nervous connections between the eyes and the brain had become effaced; 5, Meanwhile, segregation would prevent intercrossing with newcomers provided with perfect eyes, and consequently would prevent the swamping of the new characters resulting from disuse; 6, The new variety or species or genus, as the case might be, would become persistent, as long as the conditions of total or partial darkness continued.

Now these factors, so simple, so easily appreciated, that as early as 1802, Lamarck could see their force, though he only cited the case of the mole, for he knew nothing of cave animals—these factors would seem to be adequate for the production of these eyeless forms. These results of disuse seemed adequate to Darwin himself, the founder of the doctrine of natural selection; and yet the extreme Darwinians or Neodarwinians of the present day push aside or are purblind to these fundamental factors of organic evolution, and insist that the *vera causa* of the evolution of these blind forms is either natural selection or panmixia, and they likewise deny that there is any ground for the operation of the principle of transmission of acquired characters.

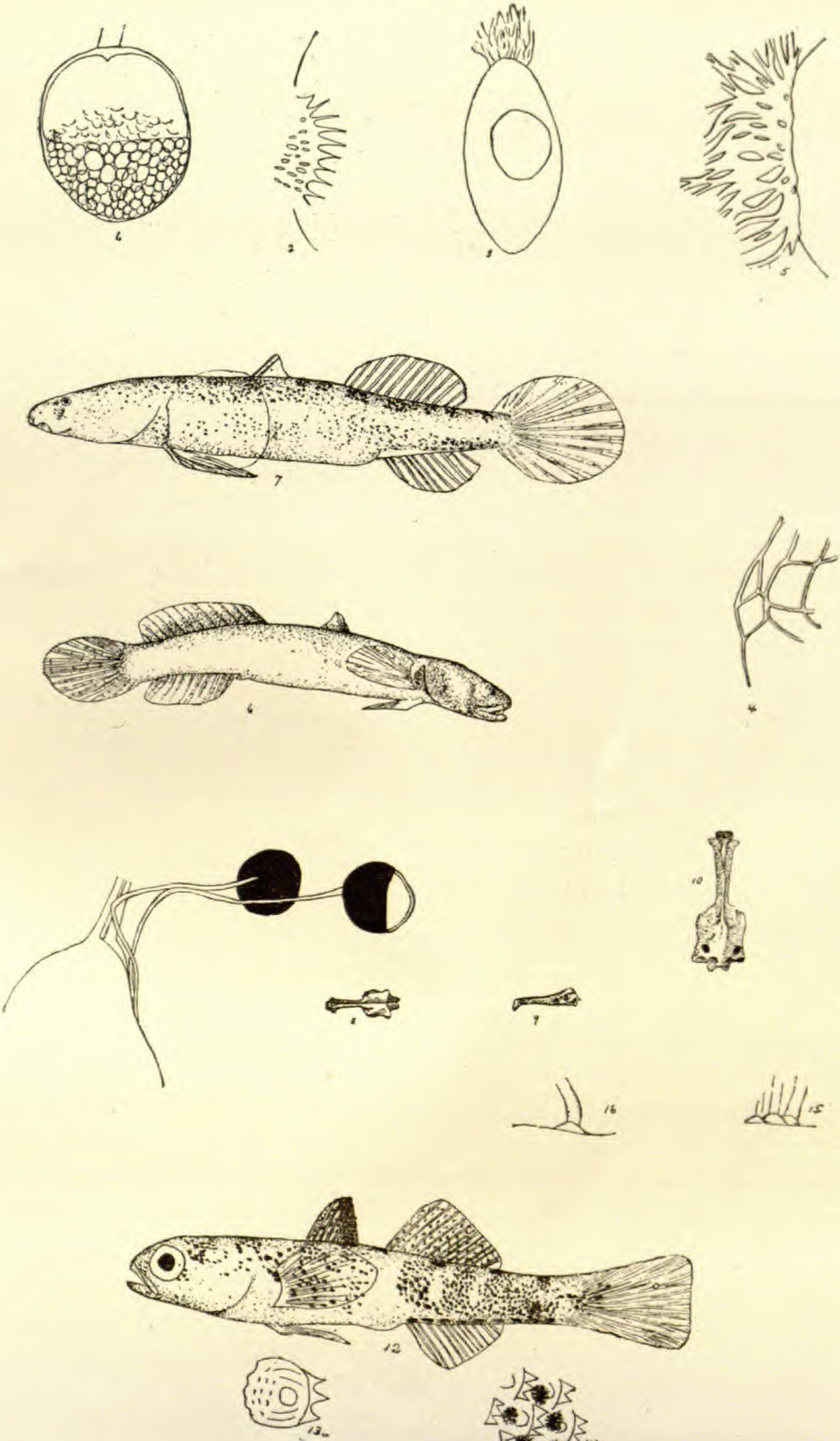
Weismann, who has rendered such eminent service to biology, in establishing the principle of heredity on a physical basis, as is well-known, pushes aside all these factors and explains the blindness of cave animals by a negative cause, "panmixia," i. e., the absence of natural selection. In his "Essays on Heredity" (1889) he claims that the small eyes of moles and of other subterranean mammals can be explained by natural selection, and remarks: "I think it is difficult to reconcile the facts of the case with the ordinary theory that the eyes of these animals have simply degenerated through disuse" (p. 86). He assumes that the degeneration of the eye of Proteus "is merely due to the cessation of the conserving influence of natural selection," and, he adds farther on, "this suspension of the preserving influence of natural selection may be termed Panmixia." And he even goes so far as to express the opinion that "that the greater number of those variations which are usually attributed to the direct influence of external conditions of life, are to be attributed to panmixia." He thus substitutes for the positive, tangible factors of change of environment, disuse and isolation, the negative and hypothetical one which he calls "panmixia."

In his discussion on this subject, as well as those of others who have adopted his views, Weismann, and his English translators, do not always give evidence of having carefully read the statements of those who have paid some practical attention to cave animals, Weismann only referring to the cases of the mole and of the Proteus. For instance, he remarks, "If disuse were able to bring about the complete atrophy of an organ, it follows that every trace of it would be effaced (pp. 90 and 292). Now in our "Cave Fauna of North America," published two years before the issue of the English translation of Weismann's essays, we have shown from microscopic sections that in the different species of blind beetles (Anopthalmus) not only is every trace of the optic ganglia and of optic nerves wanting, but also every trace of the eyes themselves. Also in the blind myriopods of Mammoth Cave, *Scoterpes copei*, no traces of the optic ganglia, optic nerves, or of any part of the eyes, including the pigment of the retina or the corneal lenses, were to be discovered. While in the blind crayfish the degenerate eyes are retained, in some individuals of an Asellid (*Caecidotaea stygia*), the eyes may be entirely effaced as well as the optic ganglia and optic nerves. On p. 118 of the memoir referred to there is a summary view of the effects upon the eyes, optic ganglia, and optic nerves, of different Arthropods resulting from living in total darkness.

Again, on p. 87, Weismann makes the following somewhat loose statement: "blind animals always possess very strongly developed organs of touch, hearing and smell." We have laid special emphasis in our essay on compensation by the development of tactile and other organs for the loss of eyesight or of eyes in cave animals, and while Weismann's assertion is true as regards the tactile and olfactory senses, it is curious that, from the direct and repeated observations of Dr. Sloan, which we quote, the blind fish occurring in Wyandotte Cave is, contrary to Wyman's and to Cope's suppositions, not sensitive to sounds.

The blind crayfish of Mammoth Cave, and also the species (*Orconectes hamulatus*) of Nickajack Cave, have, as we have ascertained by anatomical investigation, degenerate ears, so

PLATE XXIII.



Typhlogobius, Etc.

that the sense of hearing is, with little doubt, nearly, if not quite, obsolete (p. 128).

While, then, Weismann claims that there is a cessation of natural selection in the case of cave animals, another writer, Lankester, in a brief note in *Nature*, asserts that the blindness of cave animals is due to natural selection, remarking: "This instance can be fully explained by natural selection acting on congenital fortuitous variations. Many animals are thus born with distorted or defective eyes, whose parents have not had their eyes submitted to any peculiar conditions. Supposing a number of some species of Arthropod or fish to be swept into a cavern or to be carried from less or greater depths in the sea, those individuals with perfect eyes would follow the glimmer of light and eventually escape to the outer air or to the shallower depths, leaving behind those with imperfect eyes to breed in the dark place. A natural selection would thus be effected. In every succeeding generation (bred in the dark place) this would be the case, and even those with weak but still seeing eyes would, in the course of time, escape, until only a pure race of eyeless or blind animals would be left in the cavern or deep sea."

This explanation seems, however, vague and speculative, as well as inadequate, when we compare the kind of natural selection here invoked with such direct, powerful and readily appreciated factors as partial or total darkness (no plants being able to grow in caves, and only a very scanty fauna); added to the disease of organs whose very existence was originally due to the stimulus of light, and where, were it not for their enforced isolation, the swamping effects of crossing with eyed forms would constantly tend to prevent the permanent existence of blind or eyeless forms. Besides, how can the variations be fortuitous when the overshadowing and all-prevailing influence is darkness, this cause inducing a change primarily in a single organ, and, in a single sense, due to a single cause, urging the variation in a determinate way? Indeed, it may be questioned whether variations are ever "fortuitous" in the sense that they can arise independently of and are not controlled by the ever active forces of nature.

It is apparent that both of the last named writers, who have not themselves had a practical experience in collecting and studying cave animals and their surroundings, nor have carefully read the recent literature on the subject, are overmastered by speculative views, and prefer to make an extremely vague, unscientific and *a priori* speculation, rather than adopt an opinion based on the inductive method.

In refreshing contrast are the views of the veteran English philosopher, Mr. Herbert Spencer, who, like Darwin, fully appreciates the direct bearings of disuse as a fundamental factor, and, with his rare good sense and penetration, recognizes the probability of the active agency of the principle of the transmission of acquired characters in the origin of cave life.

Indeed, in caves, deep holes or burrows, or in dark subterranean streams and wells, to which the blind are restricted, we have conditions very closely parallel to those which obtain in asylums for the deaf and dumb. The array of facts presented by Professor A. Graham Bell and the danger which exists of the formation of a distinct deaf-mute variety of mankind, and the suggestions which he offers as to the most practicable way to arrest the further development of the incipient variety, all afford an interesting and striking parallel to the case of blind animals which are to be found living in caves and similar places.

The cave fauna, as a whole, is composed of individuals, all existing under the same conditions, living in partial or total darkness, and with eyes either defective or absent. Now, how did they come there? We occasionally find, all over the world, creatures with defective sight or imperfectly-developed eyes, but such cases are sporadic, and are not numerous enough in proportion to the normal population to breed together and to multiply. Where, however, individuals with more or less defective eyes should breed with normal mates, any tendency to the transmission of such defects would be wiped out by the swamping effects of crossing, owing to the immense preponderance of normal, vigorous forms with perfect vision. The whole tendency in nature in the upper world of light is to weed out such sporadic, defective forms. But in limestone regions honeycombed with caves and permeated with subterranean streams, like those in the Mediterranean regions, France, Spain, and Austria, or in those of southern Indiana, Virginia, Kentucky and Missouri—in such regions as these, there exist the conditions favorable to the origination and perpetuity of blind forms. To give an example, eyed geodephagous beetles, such as the species of Trechus, of which there are so many in southern Europe, accustomed to burrowing in the soil under stones, when carried down by various accidents into dark crevices or into caves from which they are unable to extricate themselves, and too hardy and vigorous to succumb to the deadly effects of a life in perpetual darkness, and with, perhaps, already partially lucifugous habits, such forms under these changed conditions survive, breed and multiply, finding just enough food to enable them to make a bare livelihood, and with just enough vigor to propagate their kind. We can easily imagine that in time, and indeed no very long period, the newcomers would soon become adapted to their new surroundings, an environment abnormal both from the absence of light, and from the lack of predaceous forms to devour them; and they would live on, weak, half fed, half blind, forced to make their asylum in such forbidding quarters.

Where are there, in such circumstances as these, any of the conditions which would imply that any struggle for existence or processes of natural or sexual selection in these trogloditic societies are possible? On the contrary, it seems to us that in such unwonted conditions as these, darkness, lack of suitable food, and lack of destructive, carnivorous forms, other than the blind species themselves, we are brought face to face with the more powerful, primary, purely physical agents, which have produced changes chiefly operating in a single direction, i. e., to destroy the vision and to more or less completely abolish the eyes. Here we see exemplified in a typical way the direct action of the Lamarckian factors, viz.: Change of surroundings, coupled with disuse of parts useless in such altered conditions, and then the enforced isolation, especially marked in the cases of the Proteus and of the blind crayfish, etc., which never occur out of caves, however it may be with those species living in dark wells or subterranean streams, which have a more or less direct connection with the upper world.

As regards the problem of the transmission of acquired characters, it would appear that the case with cave animals is paralled by that of deaf mutes collected together in asylums, and united by various social organizations. It has been shown in a striking way by Mr. Turner, as quoted by Bell, that "before the deaf and dumb were educated, comparatively few of them married." Bell concludes, from an examination of the records of deaf mute asylums in the United States, "that of the deaf mutes who marry at the present time, not less than 80 per cent marry deaf mutes, while of those who married during the early half of the present century the proportion who married deaf mutes was much smaller."

It was also clearly indicated that "a hereditary tendency towards deafness, as indicated by the possession of deaf relatives, is a most important element in determining the production of deaf offspring," and "it may even be a more important element than the mere fact of congenital deafness in one or both of the parents."

It appears, then, that it is the segregation of deaf mutes, inincluding nearly half of the deaf mutes who became deaf from accidental causes, which has led to the apparent increase of this incipient strain or breed of human beings. And the statistics and conclusions given by Mr. Bell appear to almost demonstrate the fact of the transmission of characters acquired during the lifetime of the individual, and that it is difficult to draw the line between this phenomenon and the transmission of congenital characters; the latter being, at present, the more frequent and therefore normal law of heredity, though it was not so in the beginning. For, as Bell, after a careful study of statistics, remarks, "The numbers of the non-congenitally deaf are evidently subject to great and sudden fluctuations on account of the epidemical diseases which cause deafness, whereas, the growth of the congenitally-deaf population seems to be much more regular."

Premising that heredity does not, at the best, always unerringly act, that its results are sometimes uncertain, even where those with congenital variations breed together or intermarry, it is also to be taken for granted that it may, at times, be impossible to draw the line between the transmission of congenital and of acquired characters.

When a number, few or many, of normal, seeing animals enter a totally dark cave or stream, some may become blind sooner than others; in others there may be developed only a tendency to blindness, the eye itself being imperceptibly modified by disuse, while a certain percentage may possess the tendency plus a slight physical defect, either functional or organic, in the eyes, especially in the optic nerves and ganglia. The result of the union of such individuals and of adaptation to their stygian life would be broods of young, some with vision unimpaired, others with a tendency to blindness, while in others there would be noticed the first steps in degeneration of nervous power and of nervous tissue. Even in a succeeding brood, or in a third brood, we might have a few individuals which were born blind or partly so, and were compelled to feel their way about the cave, while the far more numerous members of the colony would only exhibit a tendency to the disuse of their eyes, attempting to see their way rather than to feel it. Thus, after a few, or only several generations, the society of troglodytes, vertebrate and invertebrate, might be compared to a newly-established asylum of deaf mutes or to an asylum for the blind, if they interbred in the same proportions.

At first, then, the number of cases of those not congenitally blind, but which, after living for most of their life time in darkness and becoming so modified that they could dispense with the use of their eyes, *pari passu* becoming more and more dependent on the exercise of their tactile organs—at first, such individuals as these would greatly preponderate.

So all the while the process of adaptation going on, the antennae and other tactile organs increasing in length and in the delicacy of structure of their olfactory and tactile structures, while the eyes were meanwhile diminishing in strength of vision and their nervous force giving out; after a few generations, (perhaps, judging by what we know of the sudden production of deaf mutes in human societies, only two or three,) the number of congenitally blind would increase, and, eventually, they would, in their turn, preponderate in numbers.

It is also possible that the longevity of cave animals, owing to the absence of ordinary enemies and of casualties, such as occur in the upper world, even though the supply of food were greatly restricted, would be much greater than in epigaean regions. If this be so, then there is a more favorable opportunity for the development and fixation of the myopic condition in subterranean situations.

It thus appears that while the heredity of acquired characters was, in the beginning, the general rule, as soon as the congenitally blind preponderated, the heredity of congenital characters became the normal state of things, the inhabitants being all blind, and for generations breeding true to their specific and generic characters.

On the other hand if the conditions should be changed, and the cave become opened to the light, then we should expect a gradual reversion to their eyed ancestors. This process would, of course, be due to causes exactly opposite to those producing the blind form, i. e., the presence of light, etc. In such a case, neither natural selection nor panmixia would be the factors, although some one might give a high-sounding, "scientific" name to the supposed process. And this shows how inoperative can be natural selection or panmixia as true working causes of the transformation of species, compared with the operation of the fundamental factors of organic evolution postulated by the Neolamarckian.

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[5] This list is supplementary to that published in my essay on the Cave Fauna of North America Memoirs of the National Academy of Sciences, 1889, and includes some titles omitted in that bibliography, many of which are copied from Ritter's work.

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THE NUMERICAL INTENSITY OF FAUNAS.[1]

BY L. P. GRATACAP.

In the various aspects of the Development of Life upon the earth the attention of the student has been principally directed to the question of form, as a problem of derivation. The external configuration of the enclosing frame-work or envelopes of organisms, or the modified outlines of internal skeletons have been closely compared, and species have been defined upon their differences, and the record of the march of specific change, group segregation and class development compiled from their study. The enumeration of species as they multiply, or decrease and disappear has been made, and the successive expansions and contractions of the lineal avenues of descent extensively elaborated. The student has less frequently been brought to consider the question of number, the numerical increase of forms, or to attach any biological significance to the arithmetical rise or decrease of species. It is, upon a little reflection evident that the subject of numbers, if it admits of any determination, may have or must have, a direct connexion with the ease and spontaneity with which a new or old species maintains itself, and may prove an index of the severity of competition or of the difficulty of living in its field of zoological activity.

Assuming the rate of increase uniform, the apparatus and impulse to procreation identical in a number of species, that one, of course, will survive in the greatest numbers whose life is attended with the least friction, against whose functions and habits the smaller array of obstacles active and passive exist. The comparison of species in this respect, so far as it is used to make out the comparative adaptation of species to certain conditions, assumes of necessity an identical fecundity in each species, and the comparison has, therefore, valid probability between species of the same families, or genera or perhaps classes.

[1]Paper presented at Brooklyn Meeting of the Amer. Ass. Ad. Sci, Aug., 1894.

On the other hand a more recondite suggestion is made in this inquiry. Favorable conditions for the multiplication of a species, such as temperature, food-supply, freedom from enemies, habitability of station, etc., naturally assist numerical increase. But the speculation suggests differences in the time required for a species to attain *momentum*, the time required for it to reach the maximum rate of increase, when its vitality has attained such force as to most effectually overcome hampering conditions, and is recorded in the number of individuals produced at one period. This question touches the surmises made as to the manner of specific introductions. Does a species make its appearance in one example—as an individual—on the world's stage or, if diœcious, in pairs, and then proceed to establish its currency, and so in geometrical ratio of increase engage itself in subjugating its environment and dispersing or suppressing its competitors? Or do species appear in numbers, and from separated points of occupation begin spreading, until their divided areas coalesce, and their geographical coincides with their numerical maximum? Or finally does the manner of their entrance into life vary for different species, or the species of different groups in both these ways? It seems probable that the higher orders of animals—especially the vertebrates—are *sporadic* in their appearance, viz., differentiate as individuals, while the lower are *massive*, viz., differentiate in hosts.

Conditions being equal the invertebrates should reach their numerical maxima quicker than the higher vertebrates, and their maxima should, comparatively, reach enormously higher figures. What the functional activity of procreation in a new species is, cannot be determined. It would seem probable that if specific variation were a process of insensible or slightly sensible changes in forms or external physical features, the correlated disturbances of function would be imperceptible and the new species would carry on the work of self-propagation with the same energy as the allied species amongst whom it makes its appearance. The actual numerical results would be at first low, because of the smaller number of individuals of the new species and would increase as that number enlarged, and the opportunities or occasions of procreation multiplied. Again it is necessary to consider a reversal of this. The sterility of the offspring of crossed parents of different species points to the fact that there are or may be functional changes in the powers of generation, and that the new species, is, by this law, made dependent for its successful extension, upon the intercourse of similar individuals. It is likely that in connection with the rise of a new species those organs concerned in reproduction have become modified, and the system of seminal secretion, which carries with it the power of perpetuating the new forms, has itself been more or less profoundly affected. From such considerations it seems fairly probable that new species appear in limited numbers, and acquire after time the full power of propagation until with increasing numbers the maximum of their numerical rise is reached, and then that decadence begins which ends in their disappearance. It will be understood that by "limited numbers" we mean such representations of species as are much below their later and more normal development.

It then appears from such considerations, without further detail, that the factors of numerical increase are two, the external or physical conditions of life, and the internal or biogenetic force of propagation. As regards the first, the external or physical conditions of life, it may be assumed that the appearance of a species must take place under favorable conditions, if we are to accept the Darwinian hypothesis, that specific origination means that very thing, the better adaptation of new species to reigning conditions than any other, for it is its preponderant aptitude for life under these conditions that brings the new species into existence. So that as regards the encouragement to increase given by the external conditions it is unexceptional or adequate, and the rate of multiplication is then made dependent upon the physiological factor, the power and provision for propagation. These favorable conditions will be temporary. They will be succeeded by others less favorable, and the species, started under way under the best external auspices will begin to work against physical detriments and brakes that will lower its vital momentum, and, unless the biogenetic factor keeps up or even becomes intensified, the species begins its downward course, since numerical diminution means final extinction. The biogenetic factor, the influence of propagation, will, in all probability, decline with any changes in external conditions which affect the physical well-being of the organism, so that the sum of influences springing from external circumstances and internal conditions work conjointly to exhilerate or depress the life of the animal. Furthermore, although a new species responds more fittingly to its environment and possesses peculiar advantages over its companions, this species, it may be assumed, survives because it is less at odds with its surroundings, not because it is most appropriately placed. As it becomes more and more part of the new status which brought it into existence, its organism more and more nearly attains its limital fecundity.

The list of possible combinations of conditions upon the emergence of a species would then be four.

First.—Favorable Environment and High Vitality=procreative activity.

Second.—Unfavorable Environment and High Vitality.

Third.—Favorable Environment and Low Vitality.

Fourth.—Unfavorable Environment and Low Vitality.

The discussion of these four *as limital expressions*, covers the varying phases under which a species attains its numerical maximum. And this discussion assumes, for the sake of reaching definite results, that the species is considered as restrained by the boundaries of a limited area, an assumption not very much at variance with facts.

Favorable Environment and High Vitality.—In this case the species would rapidly rise to its numerical maximum, and maintain it as long as the environment and its own vitality remained propitious. But this very intensity of development would lead to the deterioration of the species, and bring about its own extinction. The competition between its own representatives would become exasperated through their great number, and this would drain the food-supply, while the excessive productivity would reduce procreative power. The zoological consequence, in this instance, would be quick numerical expansion followed by a more or less abrupt decline. Darwin says (Origin of Species Chap. X, 1860). "There is reason to believe that the complete extinction of the species of a group is generally a slower process than their production; if the appearance and disappearance of a group of species be represented as before by a vertical line of varying thickness, the line is found to taper more gradually at its upper end, which marks the progress of extermination, than at its lower end, which marks the first appearance and increase in numbers of the species." In the case of favorable environment and high vitality the line would probably begin suddenly with a thickened end, continued and increased for some distance, and slope steeply to its termination. Two examples in paleontological history illustrate this; the Trilobitic fauna of the Upper Cambrian, the Potsdam of Wisconsin and Minnesota, and the successive Ammonitic faunas of the Jura-Lias in Europe.

Prof. Hall recognized and tentatively separated three horizons of the trilobitic beds of Wisconsin and Minnesota; the earlier trilobites were referable in numbers to the genus *Conocephalites* while *Dicelocephalus* emerges in the middle beds and becomes numerically important through these and the higher beds. Prof. Hall was struck with their extreme abundance, and records his own impressions in these words; "the multitude of individuals of a few species is really wonderful; for in some beds the layers may be separated at every inch, or even half inch, and yet the entire surface is covered with the dismembered parts of these ancient trilobites." As to the Ammonites of the Jurassic they are celebrated for the sharpness of lines of demarkation between beds abounding in great numbers of the different species.

Unfavorable Environment and High Vitality.—In this case there would result a variable numerical abundance according to the equilibrium established between these discordant factors, but the average result would be a numerical uniformity extended over a considerable length of time. The procreative power would replenish the losses by death, and keep up, at least at first, a uniform amplitude of life. The unfavorable environment would work a defeating influence upon procreation, and after a length of time, bring about a low vitality which in conjunction with the uncongenial surroundings would wind up the species.

Of course the term *unfavorable* is here used comparatively, not meaning *inimical*, because a new species upon the doctrine of adaptation could not arise in hostile circumstances, but meaning less favorable than the *most* auspicious surroundings. The result as measured in numerical estimates would be a low mean, which perhaps as the environment improved might increase. It is only likely that such conditions are present when a species migrates, or is invaded by a change of physical conditions less advantageous than those it has previously enjoyed. A new species with high vitality is hardly consistent with unfavorable environment at the beginning, and the category we are considering would only be exemplified in the numerical exhibit of species whose habitat has been affected unfavorably. The repression of great numbers of individuals at any one time would tend to lengthen the life of the species, inasmuch as it would relieve it from struggle in its own midst, and this would have a tendency to extend its days.

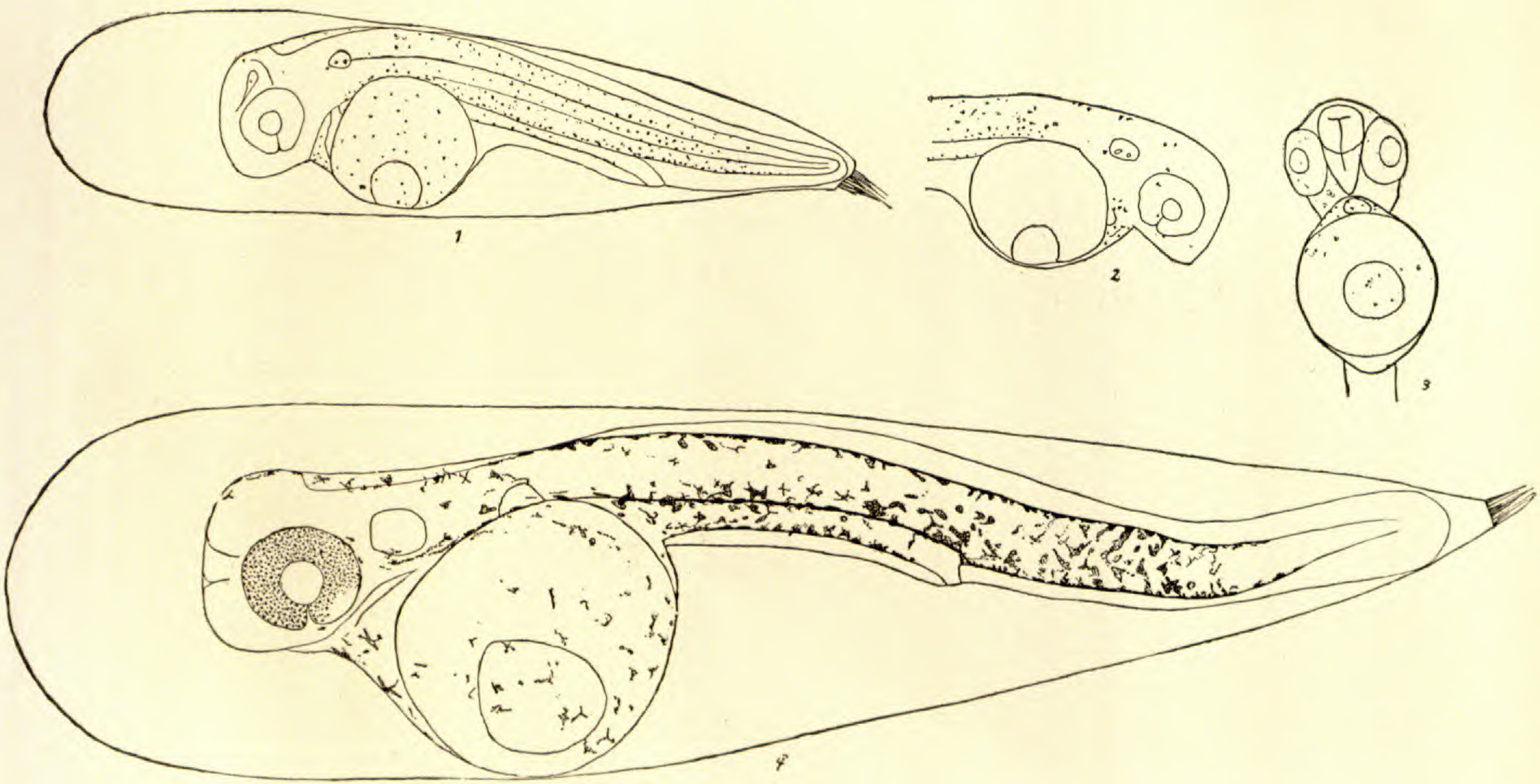
In the paleontological record the case of *Atrypa reticularis* seems to illustrate this numerical constancy. From the Upper Silurian in the Niagara through the Lower Helderberg, Oriskany Schoharie and Upper Helderberg it keeps up a more or less uniform though not excessive representation until diverging in the Devonian into *A. vexata* and *A. spinosa* it becomes itself more numerous seeming then to pass under the conditions of the first category—high vitality and favorable environment—and declining rapidly terminates in the Upper Hamilton. *Atrypa reticularis,* as is well known, does not attain a large size in the Silurian, but, according to Hall, exhibits considerable variety of form. It is in the stage of "*oscillation*," not yet having attained specific fixity and this fact of formal instability points to a lack of congruity between itself and its environment and leads us to consider it an example under this heading.

Favorable Environment and Low Vitality.—By "Low Vitality" we here designate a certain sluggishness in fecundity in certain animals though the value of the procreative energy considered at the instant of its exercise may be high. Evidently for such animals their duration in time will be conditioned largely upon favorable circumstances of life and without these they must undergo extinction. The numerical representation must always be small; it is essentially limited by their intrinsic predisposition to be slow breeders. This assumption seems applicable to species which without any apparent change in their environment become subject to a progressive failure in numbers. The history of invertebrate life on the earth's surface emphasizes this. Throughout similar conditions or what, from lithological evidence, seem *identical* conditions, species dwindle and disappear. On what hypothesis can this gradual vanishment be explained, except that the living momentum has run down, a physiological deterioration has set in, which must, no matter how auspicious be the physical requirements, compass the discomfiture and suppression of the species. Low vitality might also reasonably imply a certain functional weakness which affects the organic intregrity of a species. Under either implication, that of low procreative power or functional weakness, favorable environment fictitiously prolongs the life of the species and gives a deceptive appearance of stability to a species internally disintegrating. Its numerical ratio must be a reduced one.

Unfavorable Environment and Low Vitality.—This category symbolizes the rapid decline of a species, and is symptomatic of the final stages in its life-history. Where unfavorable conditions combine with intrinsic decrepitude the doom of a species is quickly sealed, and it vanishes from the scene scarcely noticed amidst the on-coming armies of new and intense competitors.

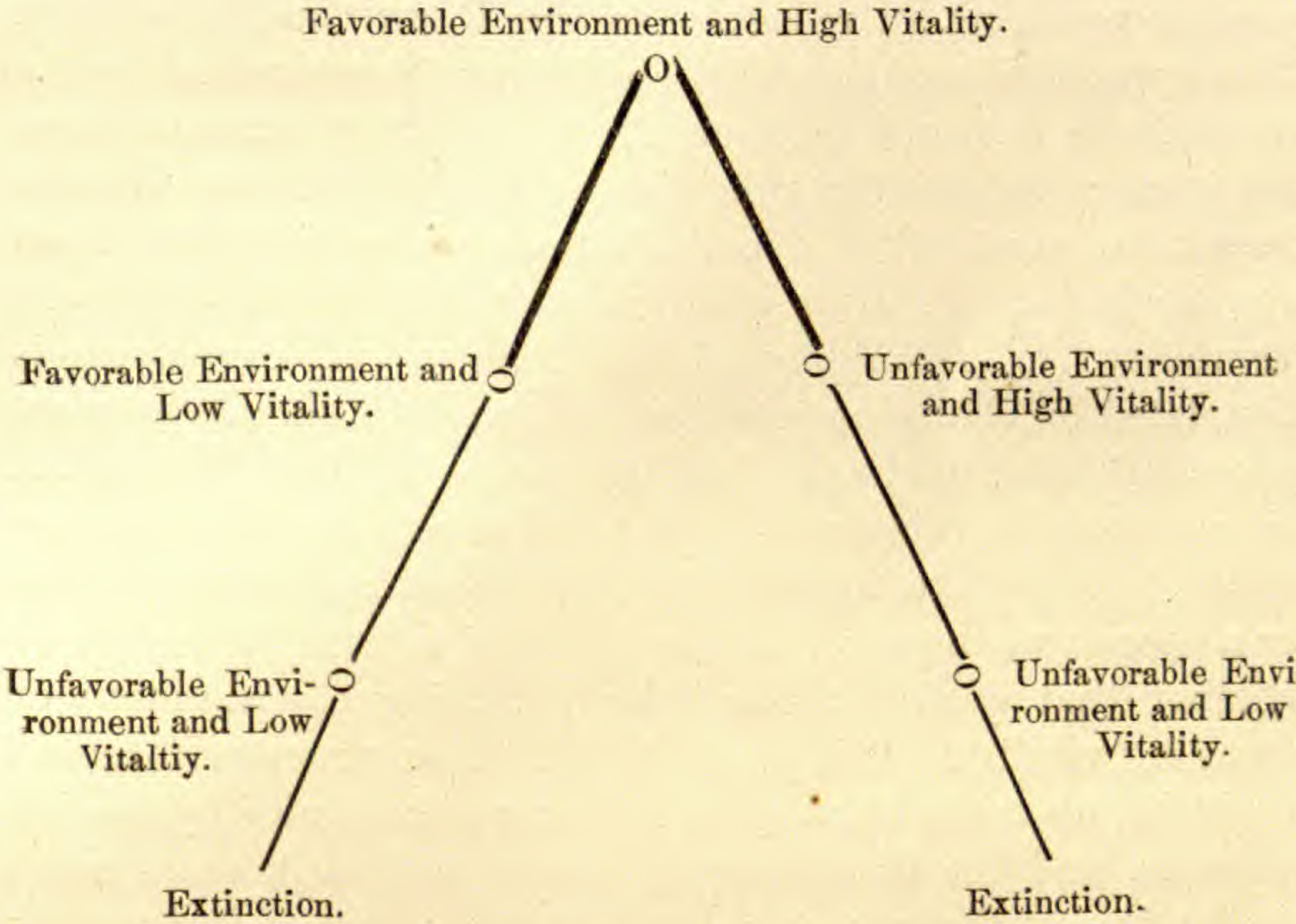
These four categories which we have epitomized, embodying the relations of *vitality* to *environment* and applied to the phenomena of the numerical abundance of a species, may be generally regarded as the formal stages of a species' decline. And we observe that the succession of these stages may follow one of two directions as divergent lines from an original condition. That original condition is *Favorable Environment and*

PLATE XXIV.



Typhlogobius.

High Vitality, for while these terms may not be co-existent upon the first appearance of a species they must quickly become so. A species originates, if we are to accept the Darwinian hypothesis by reason of its preponderant adaptation to new conditions, and if at first that adaptation is tentative or accidental, it soon becomes assured and necessary, upon the *settling down* of species and environment into a complete reciprocity. We then may expect two similar but contrasted stages to succeed this original, initial state, as is seen in the subjoined diagram; these stages presenting equivalent *numerical* zones, to be followed by two similar and identical stages, which in turn precede the extinction of the species.



The conjecture here delineated shows a species beginning under the favoring conjunction of vitality and adapted environment, rising in *numerical intensity* until a weakening of these elements sets in, and the species begins to decline in numbers. It may decline along a line of lessening vitality with environment constant, or, it may decline along a line of increasingly hostile surroundings with vitality constant, and it may be assumed that a stage of equipoise may be reached along either of these lines wherein, however, the factors of environment and vitality are oppositely related. There would then be two stages of equal numerical efficiency, opposite in conditions but equivalent in effects, favorable environment and low vitality, and unfavorable environment and high vitality, and succeeding these as an inevitable sequence comes at the end of either road of retreat, the final stage of unfavorable environment and low vitality and the extinction of the species. Along either of the avenues of deterioration the numerical intensity is supposed to decline similarly but this superficial resemblance covers a radical contrast of agencies and we are brought to consider two kinds of strain; the strain of internal weakness, and the strain of external disparity. This introduces a crucial question we think in reference to the Darwinian hypothesis. That hypothesis assumes that species are perpetuated by the concordance declared between them and their surroundings, and it seems enclosed in this wide opening statement, that the Darwinian must allow a certain power of *provocation* upon organisms from exterior conditions, viz., that the inherent variability (fully emphasized by Darwin) of organisms is stimulated by changing environment while it should be more quiescent under unchanged circumstances of life. Without at present pressing this question the inference, we think, is reasonable. Therefore, in establishing a line of numerical decline for a species we have in this suggestion a form of test as to whether that decline arises from changing environment or changing vitality. If it proceeds from changing environment it will be, upon the Darwinian theory, accompanied by specific offshoots, and the disappearing species will sink from sight amidst the emergence of related species; but, if it proceeds from devitalization it will display a species dying as it were alone, unattended by the growth of related varieties, and passing away without those bequests of derivative forms which, in the other instance, represent the yet internally vigorous species struggling to maintain its empire under the guise of modified offspring. These propositions will, it may perhaps be conceded, repay more careful and detailed application to zoological history, as it has been written in the successive ages of geology.

THE DEVELOPMENT OF THE WING OF STERNA WILSONII.

BY VIRGIL L. LEIGHTON.

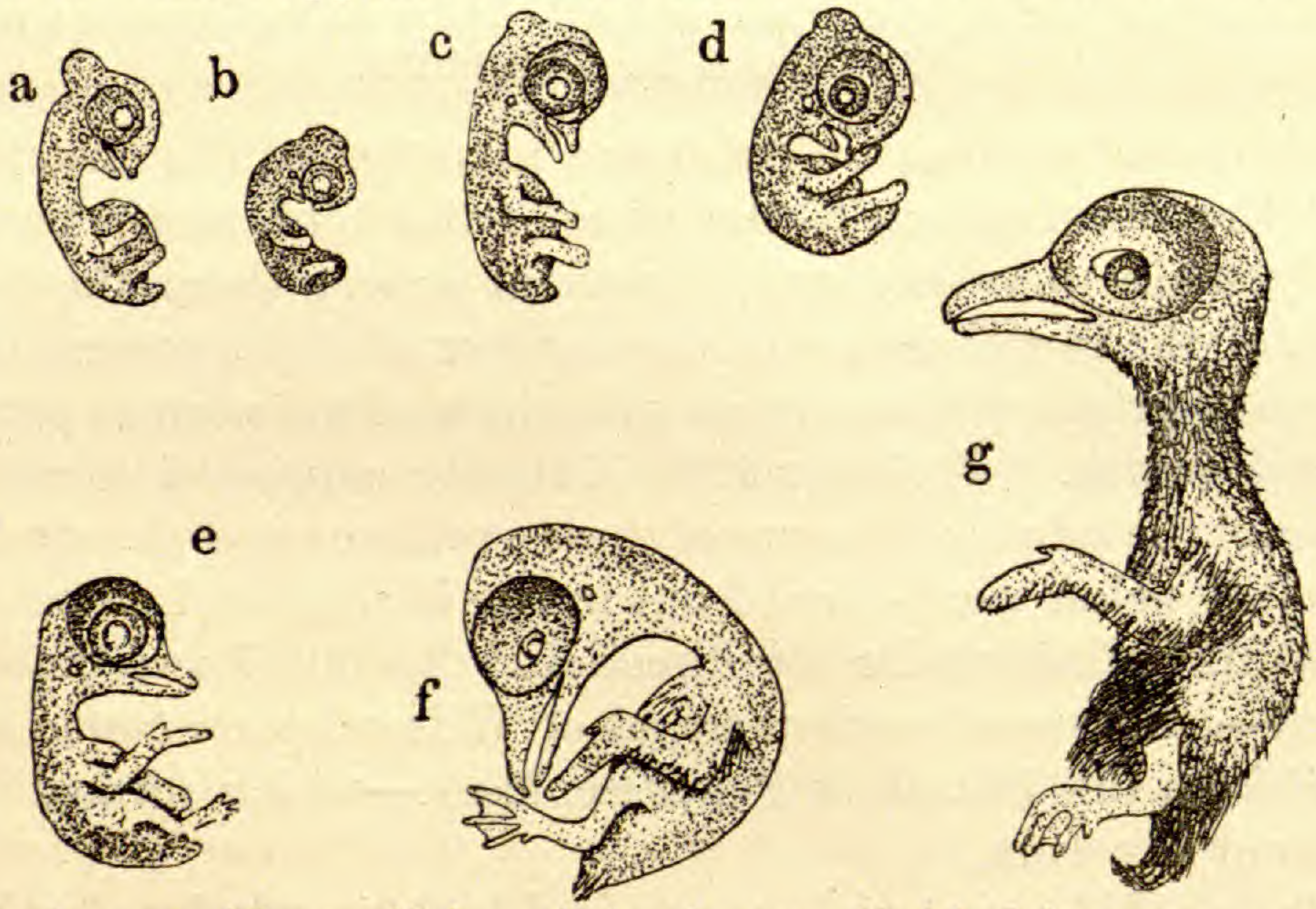
Although various students have investigated the structure and the development of the wing of the bird, many points still remain unsettled, and prominent among them, the relations of the carpal elements, the number of digits present and the comparison of these digits with those of the normal pentadactyl manus. Professor J. S. Kingsley suggested to me to attempt the solution of some of these problems and the studies detailed below were carried out in the Biological Laboratory of Tufts College under his direction. To him I owe the material—embryos of various stages of Wilson's tern, *Sterna wilsonii* from the Island of Penekese, Mass.—which formed the basis of my work.

The alcoholic material was studied both in toto by clearing with oil of clove, and by means of serial sections. The latter proved far preferable and much more dependence can be placed upon results obtained in this way, especially with the younger embryos than by the more common methods of dissection and clearing in essential oils. The figures of structural details which illustrate the paper were obtained from reconstruction projections of the sections and are magnified twenty diameters. I am not able to state the ages of the various embryos, but this is a matter of little importance since the approximate development can readily be made out from the figures of the various stages, each natural size. The numbering of the separate stages is entirely arbitrary.

I might state here, incidentally, that I have also studied to some extent the foot of the tern and I find in it, as has already been pointed out by other observers, (Miss Johnson, Studer, W. K. Parker and others) a fifth metatarsal present.

STAGE I, (FIG. 1).

At this stage (fig. a) the principal elements of the wing are becoming differentiated. The radius and ulna are entirely cartilaginous, except a small portion at their distal ends where they are least developed. In the proximal row of carpals are two masses of rapidly forming cartilage (radiale and ulnare) each of which appears to have two centers of chondrification.



The larger (the radiale, *re*) is almost divided into two parts; of these the larger and outer one is somewhat triangular in shape and is fitted upon the distal end of the radius, the smaller and inner one is nearly circular and is contiguous to the inner margin of the distal end of the ulna. The ulnare is composed of two oval centers, the proximal being about half the diameter of the distal one, thus giving the whole element a wedge-shaped appearance with its narrow end passing just outside the outer margin of the ulna.

The distal carpals are represented only by a thickening of tissue, or "procartilage" of Parker, showing as yet no differentiation into separate elements. There are *four* radiating digits represented for the most part by "procartilage," but metacarpals II[1] and IV are becoming cartilaginous at their proximal ends and metacarpal III is two-thirds cartilage.

STAGE II, (FIG. 2).

This stage (fig. b) is but slightly more developed than the last. The cartilage is a little more pronounced, and digits II,

[1]For the numbers to be given to the digits, see below.

III and IV have become longer, III and IV being segmented. The fourth digit has become free from the central mass, and more nearly approximated to digit IV. In the distal carpal series there are two masses of cartilage: on the radial side a mass which represents the combined carpales II and III, and on the side of the ulna carpale IV, an oval mass contiguous proximally to the distal lobe of the ulnare and distally to its own metacarpal.

Stage III, (Fig. 3).

In this stage (fig. c) there are several things to be noted. The spreading of the digits is not so great and the whole manus is beginning to flex towards the ulnar side, thereby displacing some of the carpals from their normal position. The elements are now all perfectly distinct, the radiale has entirely lost its bibobate appearance, and is now of an irregular shape, touching the radius and ulna and the approximate surface of the conjoined carpales II and III. The ulnare is now entirely outside the ulna, but, what seems most remarkable, its proximal portion is now about twice the size of its distal lobe, while in the stages previously described it is about half as large. The distal lobe is circular, the proximal wedge-shaped, with the small end proximal. Carpale II+III is the last carpale to chondrify, but is now all cartilage except a very small portion of its proximal end. It is an elongate mass, placed somewhat diagonally to the present axis of the limb. It is contiguous distally to the approximate surface of metacarpals II and III and carpale IV; proximally to the radiale. Carpale IV retains the same relative position as in earlier, except that it has approached closer to metacarpal III. Digits II and III have each added a segment, that of the former is partly cartilaginous, the latter is all procartilage. Metacarpal IV has approached metacarpal III and its single phalanx is entirely cartilaginous. Metacarpal V has the same appearance as in previous stages, but is farther from metacarpal IV.

Stage IV, (Fig. 4).

The specimen which forms the subject of this stage (fig. d) is in some respects slightly more developed than stage III, in other respects less so. The manus is not flexed so much, and consequently the ulnare has not been pushed so far outside the ulna. In this specimen, unlike the others, the two lobes of the ulnare are about equal in size, the distal one oval, the proximal wedge-shaped. The radiale retains its bilobate appearance as described in stage I. Carpale II+III forms a lunate mass of fully developed cartilage about the head of metacarpal III. Carpale IV is slightly smaller relatively than in the previous stage; the digits are essentially the same.

Stage V, (Fig. 5).

In the specimens (fig. e) which forms the basis of this stage, the manus now assumes very nearly the form which it has in the adult bird. The radiale is irregular in shape and fitted to the distal end of the radius, the inner distale margin of the ulna and the approximate surface of carpal II+III. The distal lobe of the ulnare is here at a minimum in comparison with the proximal lobe; it is now closely appressed to carpale IV which is wedged between it and carpale III. Metacarpal II has approached metacarpale III and on its radial side is developed a large projection or "trochanter." Its proximal phalanx is entirely cartilaginous, its distal one is just beginning to appear. Metacarpal III now bears three phalanges, the distal one not yet cartilaginous. Metacarpal IV has assumed a position parallel to metacarpal III, but is not yet united to it. Metacarpal V has approached metacarpal IV near its proximal end.

Stage VI, (Fig. 6).

In birds of this age (fig. f), carpales II, III and IV have entirely coalesced, and, together with metacarpal II, form a solid socket into which fits the head of metacarpal III. Metacarpal II bears two phalanges; metacarpal III three, their distal phalanges being unequal. Metacarpal V now touches metacarpal IV and is not so near the proximal end as in earlier stages.

STAGE VII, (FIG. 7).

There is little in this stage (fig. g) to note except metacarpal V. This is now an oval disk closely applied to the ulnar flexor surface of metacarpal IV, about one-ninth of the distance from the proximal to the distal end. It no doubt finally unites with metacarpal IV at that point.

COMPARISONS.

INTERMEDIO-RADIALE. In Sterna in the earlier stages these two elements are distinct (fig. 1); later they become so completely fused that they cannot be distinguished, although, exceptionally, (fig. 4) they partially retain their individuality for a considerable time. Similar conditions have been noted in several birds, *e. g.*, Opisthocomus, *Fulco tinnunculus* and chick by Parker and *Cypselus melba* by Zehntner ('90). In other birds the separation has not been described, possibly from the fact that the proper stages have not been studied.

ULNARE-CENTRALE. My observations here closely agree with those of Parker on the ducks and auks, there being the same tendency to subdivision of the cartilage mass into two elements which he shows. One of these is, beyond doubt the ulnare, but I confess I am not so certain of the other which I call centrale in deference to his better opinions. The conditions shown in fig. 1 where the two portions of this element are clearly shown, leads one to the conclusion that the distal lobe may possibly belong to the series of carpales, in which case it would be that of the fourth existing digit. In fig. 5 again the arrangement is such as to support such a view, while on the other hand, in none of the earlier specimens have I seen it in such a position as to indicate that it should be regarded as a centrale. In *Chloëphaga poliocephala* Parker ('90) describes this bone as divided into three portions, the two distal of which he terms centrale 1 and 2. It would rather seem as if we had here to do with a true centrale, while Parker's centrale 1—clearly, according to position, equivalent to the single one which I find—must be regarded as a fourth carpal. (Cf. Parker '90, pl. 5, fig. 14). Studer, according to the single figure copied by Wiedersheim, has different ideas. He has no such projection from the ulnare, but in his figure carpale I+II projects up between radiale and ulnare and the projecting portion is the centrale. Zehntner, on the other hand, ('90) has the intermedium united to the ulnare, the centrale to the radiale, conditions which certainly do not occur in Sterna.

CARPALS. Unless we regard the "centrale" of the preceding paragraph as in reality a carpal, Sterna never possesses more than two distinct elements in the distal carpal series. Of these that on the radial side is the larger. When chondrification begins it occupies a position (fig. 2) at the base of metacarpal III; later (figs. 3, 4) it extends radially towards metacarpal II, and even at times (fig. 4) exhibits a marked bilobate appearance. From these facts as well as its subsequent history I regard it as a compound body, the carpales II+III of the normal pentadactyle hand, the distal carpal II of Parker and most other students of Avian osteology. Concerning the "pentosteon" of Shufeldt I can say little. This author ('82^b p. 691, footnote) gives this name to a small bone found by him in Centrocercus lying at the base of the plantar surface of the second (my third) metacarpal. The name was given because it was the fifth carpal bone discovered, and because it was non-committal as to its homologies. Parker now finds the same bone in ducks and auks, occupying the same position, and regards it as carpale I. This interpretation, however, seems to me faulty, as the bone is not in the proper position for such identification, nor have we any torsion or stress which could account for such translation. It would appear rather to belong to the same category as the pisiforme, but since I have not found it in Sterna I can offer no further observations upon it.

The other free carpal element, carpale IV, is clearly but a single element and not a compound structure like that described by Zehntner, Rosenberg and others. Studer, in the penguin, also figures a broad element in this position which he doubtfully regards as compound. In Sterna this element at its first differentiation is no wider than the fourth metacarpal, and as long as it retains its free condition it remains relatively of the same size. Later (fig. 6) it becomes united with carpale II+III, the whole forming a single piece equivalent to the separate os magnum and unciforme of some birds.

METACARPALS. The only metacarpal which requires notice is V (IV of many authors). This has been more or less perfectly described by several students since its first discovery by Rosenberg ('73). This author describes it in the chick as a distal process of a common mass of cartilage which clearly contains *two* carpal elements, IV+V, since to it is also joined metacarpal IV. In the case of his figures there can be no doubt that this distal prolongation is a true digital element, as it is clearly homonomous with the other metacarpals. It is to be noted that according to Rosenberg this new metacarpal lies at a lower level than the others, being flexed towards the palmar surface. Zehntner ('90) finds the same element in *Cypselus melba*, but existing there, as in Sterna, as a piece distinct from the basal (carpal) element with which it is at first joined in the chick. According to Zehntner after 9 or 10 days, this metacarpal "geht.... bei Cypselus einen vollständigen Atrophie." This is certainly not the case in Sterna, nor is it in those forms studied by Parker. Here it retains its discrete nature for sometime and in the fowl, toucan and cariama it even becomes ossified before its final union with the basal end of metacarpal IV.

That this is a true metacarpal is, I think beyond question. Owing to the method of study adopted by Parker he failed to recognize its earlier conditions, and his observations, unsupported by other evidence might be interpreted, as has been done by several, in another way. However, the evidence adduced by Rosenberg, Zehntner and myself, clearly removes this from the category of tendinous ossifications, the pisiforme and the like.

Naturally the structures which I have described should be compared with those of the reptiles, but this to be at all adequate would require a detailed knowledge far greater than I possess. It is to be noted, however, that if, as contended in the next section, the avian "pollex" is not the first digit of the pentadactyle hand, a portion of the reasons adduced for regarding the Pterodactyls as widely removed from the birds is removed.

THE HOMOLOGIES OF THE DIGITS.

In the wing of the adult bird only three digits at most attain full development, and, since the birds have descended from pentadactyle forms, it becomes a matter of some importance to compare these three with those of the normal hand; in other words to ascertain which digits have been lost in the process of evolution. Naturally many attempts have been made to solve the problems involved, and within the last decade four different views have had their advocates, though naturally some of these ideas of homology date back to a more remote period.

Thus Gegenbaur ('64), reasoning from the apparent tendency towards reduction of the digital elements on the ulnar side of the crocodilian manus, concludes that the persistent digits of the bird wing are the I, II and III of the normal pentadactyle hand. In this he has had many followers, among them Rosenberg ('73), Huxley ('71), Jeffries ('81), Jackson ('88), and Parker ('88). For this view there are many more arguments than the one mentioned above, and Dr. Jeffries has given an able summary of them.

A second view is that of Owen, according to which the digits in question are II, III and IV. This is based partly ('36) on the fact of the absence of the radial artery, which would indicate reduction on the radial side of the manus; and partly ('62) on features supposed to exist in the British Museum specimen of Archæopteryx. In this there are apparently four digits present in connection with the right wing, but as these show considerable dislocation, one may, as suggested by Professor Owen, have belonged to the other side. This view has fewer supporters than the other, among them Morse and Coues. Morse ('72) contributes not a little in support by his advocacy of the law of digital reduction as a valid argument in this connection. That Coues supports the same view I take partly on the statement of others and partly from the fact that, while in the text of his "Key" ('87), he gives both views, the numbering of the digits is II, III, IV. In an earlier paper ('66) he accepts the numbering I, II and III. Here, too, must be enumerated Shufeldt, who states ('82, p. 616) that he has always adhered to this view, but adds "the fact, however, that the first phalanx of the manus of aves is the homologue of the pollex of the pentadactyle limb seems to be gaining ground." I have not found any further reference to this subject in his subsequent osteological contributions further than this usual reference to the radial digit as the pollex.

Mr. Hurst ('93) has advocated a third system of numbering according to which the digits are III, IV and V. An analysis of his reasons will be given immediately when dealing with the arguments for the enumeration adopted in the present paper.

The fourth system is that of Tschan ('89) who according to Zehntner ('90) proposes to regard the permanent digits as I, II and IV. He bases this on the discovery by Parker ('89) of a slip of bone in chick,[2] Musicapa and many Gallinæ as occurring between the second and third of the persisting digits. This, says Tschan, is the true digit III. But Parker further describes similar slips as occurring on the outside of the "pollex" and between the first and second permanent digits as well as a true fourth metacarpal on the ulnar side of the hand. Tschan suggests that the first of these might be the "prepollex" but even with the admission of this doubtful element, there would be one superfluous digit. This together with the utterly anomalous type of reduction which it presupposes—the disappearance of digits in the middle of the manus—is sufficient to discredit this view.

That there is developed a fourth digit in the avian manus is beyond question, and the fact that this comes upon the ulnar side of the three permanent fingers is sufficient to invalidate the nomenclature, III, IV and V of Hurst. Hurst refers to Parker's fourth digit as appearing to be the *os pisiforme*, and since Parker had only the later stages, there would be some plausibility in this view. This possibility, however, disappears

[2]It was discovered, as Parker points out, long before by Heusinger ('20, pl. IV f. 10) in the chick, persisting for sometime as a separate bone.

when we study not only my figures 1 and 2, but the figures of Rosenberg and Zehntner. In the figures just cited the temporary digit is just as prominent as is the "pollex" and no one without a theory to support would regard it other than a digit. Then too, as Rosenberg's figure shows, it bears no connection to the ulnare, but is a distinct outgrowth from the outer distal angle of carpal III+IV.

We are then left to choose between the formulæ I, II and III and II, III, IV, and though the apparent weight of authority is in the other direction, I am strongly inclined towards the second alternative, for the following reasons: First comes the law of digital reduction advocated by Morse, by which in other groups digit I is first to disappear and then V. Further, when further reduction occurs in birds, and a single digit is left as in the Apteryx and the Cassowaries, the reduction has occurred on both sides of the persisting digit, which, according to my nomenclature, would be digit III. This implies a symmetrical reduction, the other view involves the disappearance of digits I, III, IV and V, a condition, so far as I am aware, without parallel.

Then too, Archaeopteryx, in the light of Hurst's later studies presents some evidence. As noted above, Owen thought he had found evidence of a true digit I in the British Museum specimen, but on the discovery of the Berlin specimen this idea was dropped and the conditions presented by the new example form the chief argument in Jeffries' summary already alluded to. It would, however, appear that most recent figures of the Berlin specimen and the conclusions based upon them are not to be relied upon. This can be at once seen by comparing for instance the figure of Archaeopteryx given by Zittel in his Paleontologie with the photographic reproduction which illustrates Hurst's article.[3] In the Berlin specimen three digits in the wing are clearly visible, and it has been assumed that these were the only ones. Hurst, however, points out that the position of the feathers is such that they could not have been borne on these digits as in ordinary birds,

[3]The plate in the Standard Natural History (Vol. IV, facing p. 22, 1885) approaches very closely the figure of Hurst.

but that there must be (at least one) digits buried beneath the feathers, and in just the place where the missing finger or fingers should come is an evident ridge in the stone.

If we may call upon the effects of use and disuse, the conditions presented would also tend to favor the reduction of the digits on the radial side, for it is the ulnar phalanges which must bear the stress of the wing; the fingers on the radial side, having but few small feathers, would be most likely to disappear.

Jeffries invokes also the distribution of the nerves, but to my mind his evidence is not conclusive; besides it is directly negatived by the distribution of the blood vessels as was pointed out above.

We may conclude, then, that the only conditions possible are either I, II and III, or II, III and IV, and that until some evidence be found of the actual appearance of a fifth digit on the ulnar side, that there is at least as much reason for the second as for the first formula. In regard to the first, Hurst remarks, it " is in no case, so far as I am aware, supported by any evidence whatever. I believe it to have originated from the pre-Darwinian statement that the Ala spuria is 'analogous to the thumb;' while the other two digits are called simply 'second' and 'third;' that is, *second and third digits* not of the pentadactyle but *of the tridactyle fore-limb.* Such phrases written on the then undoubted hypothesis of special creation and of fixity of species, could obviously not mean that the three digits called 'thumb' and 'second' and 'third' had been evolved from the digits I, II, III of the pentadactyle fore-limb of an ancestor; the author did not believe that birds ever had such an ancestor. The transcription of such phrases into post-Darwinian treatises, without consideration of the new meaning which they would thus gain from the new context, appears to have been the origin of the error."

CONCLUSIONS.

CARPALS. There are at least seven elements in the carpus. In the proximal row there are two free elements (intermedio-radiale and centralo-ulnare) both of which are divided in the early embryo, and represent, morphologically, the radiale, intermedium, centrale and ulnare. In the distal series there are also two free elements, one of them (carpal II+III) being evidently compound.

DIGITS. There are four distinct metacarpals. The first (II) supports two phalanges, the second three, the third one, and the fourth none. The distal phalanges of m. c. II and III are furnished with claws. *M. C.* V arises as a distinct digit, subsequently becomes free, and finally unites with m. c. IV.

NUMBERING OF DIGITS. The persistent digits of the birds wing are either I, II and III or II, III and IV, the bulk of evidence being in favor of the latter enumeration.

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Explanation of the Figures.

The illustrations in the text show the embryos natural size. It is to be noted that fig. A, showing a smaller embryo, had a wing more developed than fig. B. All other figures are projections of camera drawings and are each magnified 22 diameters.

Reference Letters.

c carpale	*m. c.* metacarpal.
h humerus	*u* ulna.
r radius	*ue* ulnare.
re radiale	II–IV and I–IV digits.

Fig. 1. Manus, stage I, showing carpus and digits as procartilage with several cartilaginous elements. Digit V is plainly shown.

Fig. 2. Manus, stage II. Three carpals are now seen and metacarpal V has become distinct from the carpal mass.

Fig. 3. Manus, stage III. The digits are now broken into phalanges and the flexure of the hand to the ulnar side is forcing the ulnare out of its normal position.

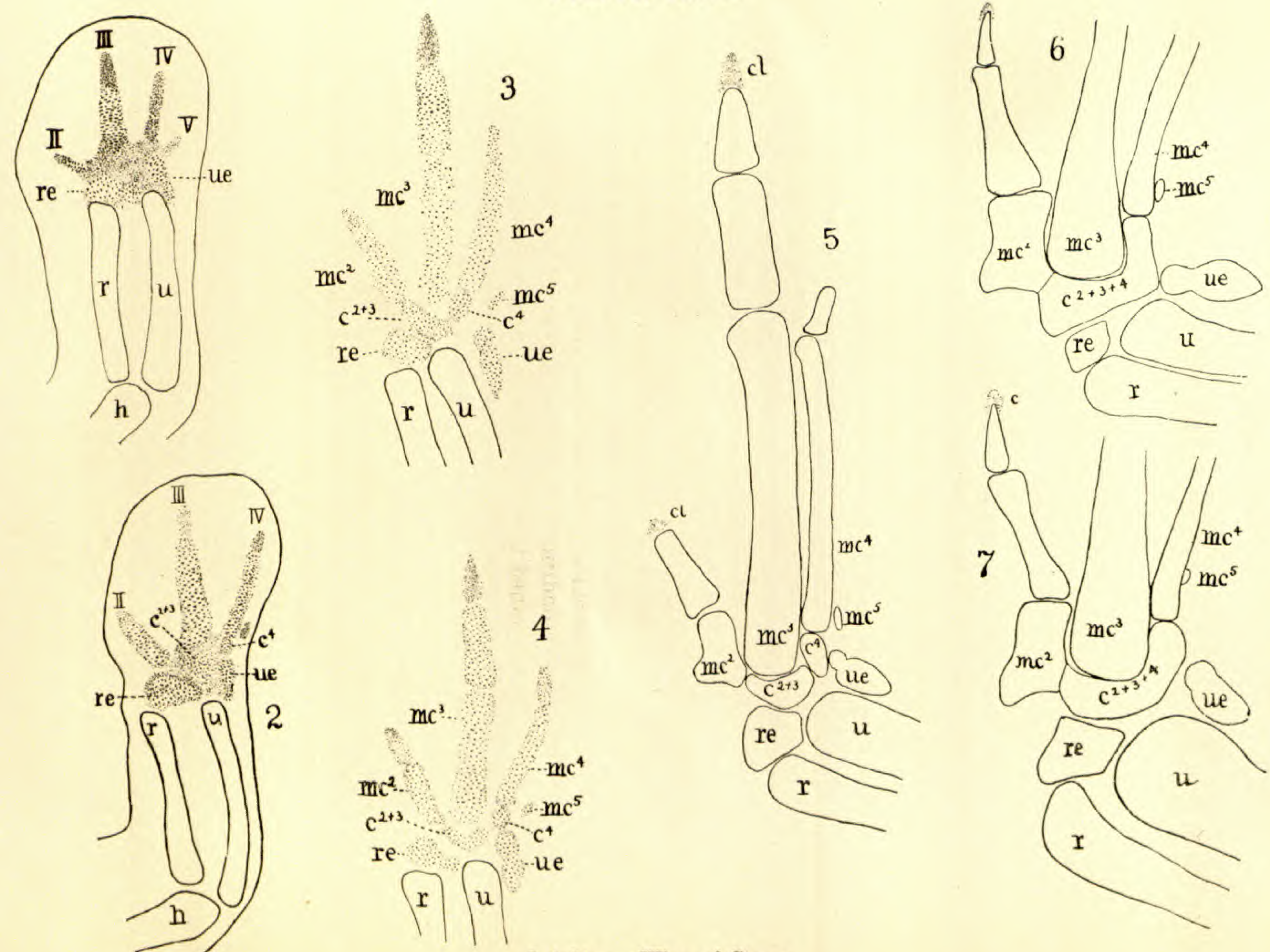
Fig. 4. Manus, stage IV. The radiale shows tendency to division into radiale and intermedium.

Fig. 5. Manus, stage V. Elements now beginning to ossify. Digits II and III are terminated with claws.

Fig. 6. Carpals and metacarpals, stage VI. Carpals united; metacarpal V approximate to metacarpal IV.

Fig. 7. Conditions just before hatching. Metacarpal V joined to metacarpal IV.

PLATE XXV.



Leighton—Wing of Sterna.

A LITTLE KNOWN JAMAICAN NATURALIST, DR. ANTHONY ROBINSON.

BY T. D. A. COCKERELL.

There are, in the library of the Institute of Jamaica, some interesting old manuscripts, together with a number of drawings which constitute almost the sole record we have of the scientific labors of Dr. Robinson in the island. The drawings are original but the manuscripts are copied from the papers left by the learned doctor, which latter appear to have been lost. The following notice is appended to the copy:

"This [is a] faithfull transcript of Mr. Robinson's loose unconnected and detach'd papers, by Rt. Long, who has revised the whole and corrected the errors of copyist thro-out. Septr., 1769.

"Anthony Robinson, Chirurgeon, formerly of Sunderland by the Sea in Durham, but lately of Jamaica."

In the Jamaica Institute is a pencil drawing of the doctor, by Edward Long, in connection with which Mr. F. Cundall has written the following biographical note:

"Anthony Robinson, surgeon and botanist: a native of Sunderland, England, where he was apprenticed to his father, a surgeon and apothecary: early turned his attention to botany: came to Jamaica: made a collection of several hundred figures and descriptions of Jamaica plants and animals: the drawings are in the Institute of Jamaica, with a copy of the MS. made under the supervision of his friend, Robert Long. (The original MS. is lost). His notes were used by Lunan in his "Hortus Jamaicensis," and by Gosse in his "Naturalist's Sojourn" and "Birds of Jamaica." The House of Assembly voted him £140 in 1767 for his discovery of the method of making soap from the juice of the Coratoe. *d.* 1768." (Journ. Inst. Jamaica, Vol. 1, p. 327).

Although Dr. Robinson did not himself publish, some of his notes have been used by later writers, as stated above. The greater part of the manuscript, however, is still unpublished, and not long ago it was debated whether the ornithological observations should not be issued by the Institute, accompanied by a selection from the colored drawings. This project after consultation with an experienced ornithologist, was abandoned, at least for the present, as so large a portion of the manuscript consists of elaborate descriptions which would practically duplicate those in existing works. Had these descriptions been published when Dr. Robinson wrote them, their value would have been very different.

The extracts from the manuscript by Gosse in his well known works sufficiently testify to the scientific zeal and knowledge of Dr. Robinson, although his methods were rather those of an age now past. I brought with me from Jamaica copies of several unpublished portions of the manuscript, and will give a few extracts, both to illustrate the character of the man and put on record observations which, although so old, have not lost their value.

1. The Alligator (so-called) of Jamaica, *Crocodilus americanus.* The following selections are from a long account of this animal:

" A very small alligator was put into rum by Mr. Walker, then of Old Harbour, now of Kingston, and according to the nicest reckoning with a watch or other time's measure, liv'd about a quarter of an hour in that spirit."

Of another specimen, " the stomach's contents were bird's feathers (aquatic most probably), joints of crabs claws, and little living white slender worms, with some small pebbles."

The parasitic worms deserve attention ; have they been described? In the horned lizard (*Phrynosoma*) of this part of the world (N. Mex.) one finds also such worms.

Dr. Robinson proceeds to describe the crocodile's external features and anatomy : " The guts measuring from the stomach to the end of the intestinum rectum were fifteen feet long, uncoil'd.

" The time the young alligator continued under water was to the outmost but two minutes, as we proved by repeated trials, puddling and disturbing the water in order to keep him under thro' fear as long as his nature would admit.

"He seldom raised more than his nostrils above the water, he ever delv'd at the near approach of any person.

"Taken out of the water, the creature breath'd or made an indraught of air to his lungs, from five to ten slow and regular respirations, and at the end of the fifth, or the tenth time, was a total cessation from breathing for about one minute."

In another place he writes: "Once this animal was observ'd to continue under water upwards of ten minutes.

"I turn'd the alligator on his back and while I staid by him he lay as if lifeless without the least motion, as I observ'd lizards do when turn'd on their backs; I retir'd for about three minutes out of his sight, and on my return he had recover'd his first situation.

"The tail's extreme I caus'd to be broil'd on the creature's dying, and ate of it. The flesh was extremely white, firm, sweet, moist and juicy, as turtle in whiteness but not so dry, not the least musky in taste or smell. My little spaniel dog ate very greedily of it." This alligator was a young one.

The true alligator, it should be remarked, is not found in Jamaica.

2. *Elaps*, probably *E. fulvius;* not Jamaican.

"A snake known by the name of the poison snake among the Indians, but among the Europeans by that of Barber's pole. The Indians have no cure for the bite of this creature, it being mortal in 10 or 15 minutes, the patient bleeding at mouth, eyes, and nose, and thus letting out his life."—(Charles Harris).

"The gentleman who wrote the above is son to Revd. Mr. Harris, late Rector of St. Elizabeth [Jamaica] who was in company with an Indian that died from a bite of the above snake, which he takes to be a species of that received from Walrond Teason, Esq., which came from the Spanish main. I have described it the Ring Snake because its body is surrounded with black and yellow rings. Mr. Harris saw the above on the Moskito shore."

The snake is now commonly called the coral snake, but the title mentioned, "Barber's pole," is more suggestive of its appearance. No poisonous snake inhabits Jamaica.

3. Names of lizards. Dr. Robinson writes Guana uniformily for what is now called the Iguana; and for what Gosse writes Galliwasp (*Celestus occiduus*), Robinson has Gully Wasp. In another place Robinson calls the same lizard Gully Asp, which explains at once the origin of the name. He observes: "The lizard tribe in general have nothing poisonous in their bite, but the Gully Wasp is strongly suspected. Cattle and mules are said to be often bit by them and so swell and die."

This notion reminds one of that current in New Mexico, of the fatal effects of Phasmids on cattle when eaten by them.

4. The Gully Asp, *Celestus occiduus*.

"The Gully Asp inhabits morasses and the banks of rivers, and gullys in the plains and mountains. They live upon fish, fruit and even human excrements. They stand upon the banks of rivers, etc., and watch for the fish coming within reach, when they suddenly spring upon them into the water and bring them out in their mouths to the shore, where they eat them. I have been informed that they are oviparous and lay eggs as big as those of a pullet, but I have not yet seen them. I have often been inform'd that no animal will eat the carcass of this creature, and the following instance seems to prove them unwholesome:

" Dr. David Miller inform'd me that a few days ago an acquaintance of his in his way to Mr. Miller's happen'd to kill a small Gully Wasp of about fifteen inches long and brought him to his house and flung him into an inclos'd square where he kept a young alligator of about five feet long. The alligator immediately swallow'd the Gully Asp. This was about 11 o'clock in the forenoon. About four hours after, the alligator (Robinson writes it aligator) was observ'd to jump and flounce about the square, knocking its head and tail against the stockades, seeming to be quite mad and frantic with pain, and continued in the manner till night, when he died. Therefore, the Dr. concluded that the Gully Asp had poison'd him; he says besides that no creature will touch the dead Gully Asp. it should seem that most animals by a natural instinct shun the carcass, and therefore avoid the certain destruction that would happen to them by eating them.

"Yet I believe it is not the flesh of the Gully Asp that is pernicious for two reasons. First, because the negroes at Egyp(t) Plantation often eat them, and secondly, I cannot think that any of the fleshy part could be dissolved in the cold stomach of the alligator in so short a space of time as four hours, besides the hard scales of the Gully Asp's skin would hinder the digestion not a little. What part of this animal is poisonous? perhaps the viscera, but which? This might be known by giving some creature, as a dog or cat, the different parts of the animal to eat at separate times."

Gosse does not admit that this lizard has any injurious properties. The above anecdote about the alligator (crocodile rather), though interesting, is hardly conclusive by itself. Later, Dr. Robinson writes:

"May the 25th, 1760. I was at St. Tooley's, where the overseer, Mr. Watson inform'd me that the Gully Asps about that estate were very fierce and would seize a man, and that their bite, he assur'd me, was certainly venomous. Memorandum to inquire more strictly into this matter." Later he writes:

"A gentleman in St. Elizabeth's informs me that in the mountains there they have a Gully Asp entirely black, which is said to be poisonous, and that if it bite either man or beast they certainly die. He gave me an instance of one biting a girl on the toe (I think), who expir'd a few hours after receiving it. . . . However, this gentleman and almost all other considerable persons in this parish and the next seem to look upon the Great Morass Gully Asp, which I think it may properly be call'd, as an inoffensive creature; the above-quoted person tells a story of a person who while he slept in the morass one night, laid hold of his cap and endeavour'd to pull it off. The gentleman observing this after the first tug, lay close, and quite mistaking it for a negro, resolving to watch him; and the next pull the Gully Asp gave he laid fast hold of him, but perceiving his error throw him backwards some yards. He says he has often fed them with offal, when he has been eating, and suffer'd them to run over his legs."

5. The following observations on a Cœlenterate which I will not pretend to determine, seem to have a bearing on some quite recently published researches.

"Small, clustering Actinea. Amongst the surrounding rocks of Booby Quay, *Actinia minima viride racemosa*, the clustering small green Actinea. These grew many together, they were about an inch long, of a round form like an earthworm. Their arms extended themselves to the diameter of one's thumb-nail, and nothing could be more pleasing than to lean down and observe some hundreds of these animals with their arms extended in the form of a stellate flower with its disc, which the mouth represents, and its rays the extended arms of a various green color as deeper and paler in circles, supported by deep green pedicels smaller than the fore-quill of a goose, and waving to and fro by the undulating motion of the water.

"From their bases are produc'd young ones, and from thence others which never fall from the mother or parent animal, as in the polypus, by which means, they grow in vast numbers, together so thick as to hide the rocks they grow upon entirely, and may be rais'd up as one body, where their bodies are observ'd to unite to one another. Their bodies are firmer and harder in handling than those of the common Actinea, nor do they shrink so much but only close their arms. They growing upon naked rocks so that they are always visible and taken by the incuriose (sic) to be a kind of sea-moss; at low water many of them are bare, at such times they never disclose or expand their arms."

Perhaps some reader will be able to supply the name of this "Actinea."—Agricultural Experiment Station, Las Cruces, New Mexico, March 4, 1894.

EDITORIALS.

—THE Forty-Third Meeting of the American Association for the Advancement of Science took place in Brooklyn, commencing on August 15. The weather was propitious and members attended to the number of 475. Many meritorious papers were read, and the addresses of the Vice-Presidents presented science in its varied aspects. The introductory address, in reply to the welcome of the citizens of Brooklyn, by the President, Dr. D. G. Brinton, was an admirable exposition of the methods and aims of science. Four lectures were delivered in the evening—the address of the retiring President, Professor Harkness, and three by Messrs Fernow, DuChaillu and Cope. The citizens of Brooklyn entertained the Association with unusual hospitality in the matter of excursions. The neighborhood of New York offers many opportunities in this direction, of which the Association freely availed itself.

The Association has, for several years, missed from its meetings an important contingent of the workers of the country. We refer especially to the anatomists, embryologists and physiologists. The principal object of the Association is to present to the American public an illustration of the work done by the investigators of the country, that they may, in some degree, understand its value. The absence of these gentlemen reduces the value of the Association as an object lesson, and detracts from the force of the impression which the Association should make. Their absence diminishes the prestige of the workers in science in this country. Original research is but little endowed in America, and it is likely to remain so unless the investigators make themselves and their needs known.

The newspapers of Brooklyn gave good reports of the meeting, but those of New York, with some few exceptions, burlesqued the Association. This shows that mental degeneracy is not confined to the rulers of New York, but has gotten a strong hold on the alleged intelligence of the city, viz.: the Press. As New York, however, is not the United States, this matters little, except to New York.

THE tariff bill which has just passed Congress contains the following provisions, which benefit scientific work in this country. The Congressional Committees which have prepared it have been interviewed from time to time by members of the committee appointed for that purpose by the American Association for the Advancement of Science, with the result of placing on the free list the following items: Scientific books and periodicals devoted to original scientific research, and publications issued for their subscribers by scientific and literary associations or academies, or publications of individuals for gratuitous private circulation, and public documents issued by foreign governments; books and pamphlets printed exclusively in languages other than English.

All manufactures of metals not otherwise provided for, reduced from 45 to 35 per cent. ad valorem, or a reduction of 22 per cent.

These provisions almost remove the onerous and disgraceful tax on education and science, which characterized the McKinley bill. It only remains to continue the work, so well begun, of the removing the tax on philosophical apparatus. The Association continued the committee.

THE address of Lord Salisbury at Oxford before the British Association for the Advancement of Science, as its President, is a general review of the present status of selected leading questions in all of the great departments of scientific research. These are treated in a simple and straightforward manner, so as to be fully comprehensible to the lay member. The value of such an address, in informing the public of the nature of the problems which have been solved and are awaiting solution by scientific research, is great. It will also benefit the cause of science in England that so distinguished a member of the ruling class should espouse it in so conspicuous a manner. Lord Salisbury adopts the hypothesis of organic evolution, but, like Lord Kelvin, declines to regard Darwinism as a full exposition of it. Against it he appeals to the evidence of intelligent design to be seen in the organic world. He does not refer to the doctrine of kinetogenesis, which so well explains the nature of design. He is not, however, prepared to accept as a necessary corollary of the fact of evolution, the origin of man from preëxistent Quadrumanas, but calls it "not proven." This is probably as much as we can expect at this time from any one who is not a specialist in biology.

WE understand that among the animals imported from India by W. K. Vanderbilt for his park near Newport, R. I., are several mangooses. It is important that these animals should not escape from confinement, as they will inflict great injury on the native and domesticated fauna should they do so. They multiply rapidly and devour every living thing sufficiently important to serve them as food, whether they live under the ground, on the ground, or at a distance above the ground to which they can climb. Having no natural enemies in the country, they would become a much greater evil than the English sparrow. Their importation, except for zoological gardens, should be forbidden.

SOME industrious persons are endeavoring to utilize parts of the great Palisade dyke of the Hudson for paving-stone. The New York journals are publishing protests against this vandalism, which will, we hope, have the effect of preserving this imposing feature of the scenery of that region.

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ZITTEL, K. A. VON—Die geologische Entwickelung, Herkunft und Verbreitung der Säugethiere. Aus den Sitzungsb. der math.-phy. Classe der k. bayer Akad. d. Wiss., 1893. Bd. XXIII. From the author.

RECENT LITERATURE.

Louis Agassiz: His Life and Work; by Chas. Frederick Holder, M. D.[1] In this volume we have an appreciative history of Agassiz, in which the characteristics of the man, and the nature and progress of his work are most happily woven together. His ambitions, while still under the parental roof in Neuchatel, are recounted, and his biographer shows how early the dominant bias of a man's life may appear. We are told how his persevering devotion to his favorite pursuit did not prevent him from preparing for the practice of the medical profession, as a means of livelihood; and how, later, the opportunity of studying and reporting on the fishes brought home by Von Martius from Brazil, determined his future course. Every naturalist has been introduced to his life work in the science by especial facilities enjoyed for the study of some particular group. To Agassiz this group was the fishes, and his first works after that on the fishes of Brazil, were those on the fresh-water fishes of Europe, and the Fossil Fishes. But his highly appreciative mind was directed to all the problems offered by nature to human thought, and he quickly saw the importance which attached to the study of the Swiss glaciers. The far-reaching results of this work are now common knowledge; as it contains the key to the superficial geology of the temperate regions of the earth. The application of the glacial phenomena in geology is Agassiz's greatest achievement.

The history of Agassiz's work in the United States is interestingly told, and the narration of the Brazilian expedition is charming. The volume closes with a reprint of some of the memorials which expressed the feelings of naturalists at the time of his death, and with a bibliography.

The work is handsomely illustrated, largely from photographs made during the Brazilian expedition. It is a pity that better figures of the Brazilian fishes and turtles could not have been copied, as those in this book are mostly bad.

The personal characteristics of Agassiz are pleasantly described, and for this reason among others the book will be a valued souvenir to the friends who knew him. The author dwells especially on his great mer-

[1] 8vo, pp. 327, illustrated. G. P. Putnam's Sons, New York and London, 1893.

its as a teacher, which, indeed, cannot be exaggerated. He greatly popularized the pursuit of science in America, and the effect of his life and labors in this direction has been greater than that of any man, probably of many men. The pursuit of science was to him, as it should be to all, a duty undertaken for the elevation of human thought. That the visible nature is the material expression of the thoughts of God, was Agassiz's oft expressed belief. Doubtless he was correct, but the proof of it comes in a way different from that which this great naturalist anticipated; that is, through the direction of evolutionary descent. Perhaps if Agassiz had lived longer, he would have adopted this view, and embellished it as he did all his teachings.—C.

Nuttall's Ornithology.[2]—This hand-book of ornithology is published in two handsome volumes 8vo, of some 400 pp. each. It is practically a new edition of Nuttall's Manual, which has been out of print for several years, to which the editor has added brief notes relating the results of recent determinations in distribution and habits. The introduction is given exactly as it appeared in Nuttall's second edition, and the text of the biographical matter has been changed but little. To this Mr. Chamberlain adds a description of the plumage, nest and eggs of each species.

In his treatment of the subject, the author covers the entire area of the Eastern Faunal Province from the Gulf of Mexico to the Arctic Ocean. The nomenclature adopted is that of the Check List issued by the American Ornithologists' Union. The illustrations are mostly drawn especially for the work. They are of excellent quality and are of size appropriate to that of the pages.

Nuttall's Manual was for a long time the only text-book of American ornithology available to pockets of limited resources. Its style and treatment of the subject are most attractive, and it has probably done more to diffuse a knowledge of the subject than any other work. Boys read it who had access to no other, and many naturalists of to-day date their interest in their science to the charm of its pages. Although the excellent works of Coues and Ridgway have made us better acquainted with the science of ornithology, nothing has superseded Nuttall's work as a delineator of habits and manners of birds. It was a happy thought that resulted in the publication of this new edition under Mr. Chamberlain's editorship.

[2] A Popular Hand-book of the Ornithology of the United States and Canada, based on Nuttall's Manual. By Montague Chamberlain. Boston: Little, Brown & Co., 1891.

Seeley on the Fossil Reptiles: II. Pareiasaurus; VI. The Anomodontia and their Allies; VII. Further Observations on Pariasaurus.[3]—Professor H. G. Seeley has again made the scientific world his debtors by his descriptions of new forms of South African fossil reptiles; by his extensive comparisons of the characters of these, the oldest known members of the class; and by his very full study of that remarkable form, the Pariasaurus of Owen. These works are valuable to students of the Reptilia of corresponding age in other parts of the world, and especially to those of the American forms. The descriptions are elucidated by cuts and plates.

Prof. Seeley has shown that the genus Pareisaurus is allied to the American Diadectidæ, and that it represents a distinct family of the same order, the Cotylosauria. His proposition of a new ordinal name, Pariasauria, is perhaps due to the fact that the original definition of the Cotylosauria was defective in one respect. The corrected definition was published later, and in the same year as the proposal of the new name by Dr. Seeley.

Several important points of both anatomy and taxonomy are presented in these memoirs, on which I propose to touch. In the first place, no one had, at the time that these memoirs were written, distinguished between roof-bones and the bones of the brain case, in the Reptilia. Although the two series are to be entirely distinguished in all vertebrates which possess them, the same names have been used variously for opposite or adjacent elements of both. The names squamosal, epiotic and opisthotic have thus been used in double senses. For the posterior bones of the temporal roof I have adopted the terms zygomatic, supratemporal, supramastoid[4] and tabulare.[5] The supratemporal is called squamosal by Seeley. But the squamosal is a bone of the lateral wall of the brain case, and cannot be identified with any one of the three possible post-orbital bars of the Reptilia, which may be composed posteriorly of either the zygomatic, supratemporal or supramastoid. The epiotic of Seely and of some others is the tabulare m., and has nothing to do with the original epiotic of Huxley.

Prof. Seeley describes the Placodontia as possessing two occipital condyles, which have the position of zygapophysial articulations. The basioccipital he describes as presenting "a thin film of bone" posteriorly on the middle line. Perhaps the basioccipital bone with its con-

[3] From the Philosoph. Transac. Royal Society of London, 1888, p. 59; 1889, p. 215, and 1892, p. 311. Illustrated.

[4] Transac. Amer. Philosoph. Soc., 1892, 11.

[5] Proceeds. Amer. Philosoph. Soc., 1894, 110.

dyle is caducous, as it is in the Diadectidæ, and has been lost from the specimens Dr. Seely has examined. It is this peculiarity that led me into error in my first diagnosis of the Cotylosauria.

Prof. Seeley makes quite full comparisons with the forms of the American Permian. He seems impressed with reptilian affinities in Eryops. But this genus is a true Stegocephal in every respect, and has no greater affinity with the Cotylosauria than any other member of the order. In quoting my description of the tarsus of the Clepsydropidæ, he falls into error in stating that I allege that "the tibials and centrals united to form an astragalus." I have stated that the intermedium and centrals unite to form the astragalus. He also states that I have not figured the intercentra of the Pelycosauria. He will find that my figures of Clepsydrops and Dimetrodon represent them.

Dr. Seeley shows that the structure of the vertebral column and pelvic arch have a close similarity in the Cotylosauria, Anomodontia and Theriodonta of South Africa. I have discovered the same characters of these regions in the Cotylosauria and Pelycosauria of North America. For the order which is to include these divisions, Seeley, like Lydekker, retains the name of Anomodontia of Owen. But Owen originally proposed this name for the group which includes the genera Oudenodon, Dicynodon and Lystrosaurus (Ptychognathus Owen). Further, in his work of 1876[6] on these reptiles, he continued this use of the name, making it of equal rank with the Theriodonta. It being evident that the entire division required a name, I gave it that of Theromorpha (Proceed. Amer. Philosoph. Soc., 1880, p. 38); (subsequently altered to Theromora, on account of preoccupation.) The use of the name Anomodontia for this order has no support in the rules of nomenclature.

Dr. Seeley discusses the possible relation of the Pelycosauria of the American beds with the African Theriodonta. There are important resemblances between these groups. Unfortunately, corresponding parts of the two are in several cases unknown. Thus the shoulder girdle and tarsus of the Theriodonta have not been yet obtained. Until these lacunæ are made good we cannot determine the mutual affinities of the two. We naturally look to Prof. Seeley for more light on this subject. It is possible, also, as I have suggested, that the postorbital arch of the Theriodonta is the superior arch (supratemporal), and not the inferior arch (zygomatic), as in the Pelycosauria.

NOTE.—In my paper on the Plesiosaurian skull (Proceeds. Amer. Philos. Soc., 1894, p. 111, line 10), by a lapsus calami, I wrote Proterosauria for

[6] Description of the Fossil Reptilia of South Africa in the British Museum.

Procolophonina. In my paper on the postorbital bars of Reptilia (Trans. Amer. Philos. Soc., 1892, p. 16, bottom) I refer to the postorbital bar of the Theriodonta, meaning the Pelycosauria. This is due to the premature assumption by English authors, to which I at the moment assented, that the two groups are identical.—E. D. COPE.

Scott on the Mammalia of the Deep River Beds.[7]—In this handsome memoir of 130 pages we have recorded the results of the Princeton College expedition of 1891. The region explored is the valley of Deep River, one of the upper tributaries of the Missouri in Montana. This formation was observed to contain fossils by Grinnell and Dana in 1875, and was explored by a party sent by the present reviewer in 1878. The latter reported from it twelve species of Mammalia all of which were new except a Prothippus of Loup Fork age, and a Protolabis of uncertain species. The Princeton expedition obtained twenty-two species, of which eight are new to science. Prof. Scott prefers to call this formation by the name of Deep River, rather than the Ticholeptus bed, as it was originally named by Cope. This is because the name Ticholeptus, as a paleontological term, is a synonym of Merychyus. However, as applied to a formation, it was not preoccupied, and it is doubtful whether, under the rules, it can be changed.

The new forms belong to the following orders : Carnivora, 2 ; Glires, 1 ; Perissodactyla, 2 . Artiodactyla, 3. The most important addition to the Carnivora is a new genus of Canidæ, Desmatocyon, which agrees with Canis, except in the possession of three longitudinal convolutions of the cerebral hemispheres. The Glires are represented by a new Steneofiber. The most important novelties are two species of three-toed horses, which are named respectively *Desmatippus crenidens* and *Anchitherium equinum,* the latter the largest known American species of its genus. Prof. Scott takes occasion to present a new classification of the genera of American three-toed horses, distinguishing four genera in species formerly referred to Anchitherium. These are Mesohippus, Miohippus, Desmatippus (nov.) and Anchitherium. Scott has already shown that Mesohippus differs from the other genera in the absence of pits of the incisors, and he assumes that Miohippus, named but not distinguished by Marsh, possesses those pits, although he states that its upper incisors are not known. I can state that this supposition is perfectly correct, as they are present in the species I have called *Anchi-*

[7] From the Transactions of the American Philosophicel Society, 1894, Vol. XVII, p. 55.

therium equiceps, A. longicriste and *A. praestans*, from the John Day Beds of Oregon, the horizon of Miohippus. The separation of Miohippus from Anchitherium is proposed by Prof. Scott, on the relative size of the conules of the molars, on the form of the external face of their external wall, and on the separation or confluence of the posterior transverse crest with the latter. The first two characters do not appear to me to be of generic value, while the third is probably a valid one. On this basis the John Day *Anchitheria equiceps, brachylophum*, and *longicriste* mnst be referred to Miohippus, while *A. praestans* is an Anchitherium. That is, supposing Marsh's type of Miohippus possess the character referred to, which is unknown. The same character will refer Desmathippus to Anchitherium; and the other characters regarded by Prof. Scott as distinguishing the two, do not seem to the reviewer to be of sufficient value to forbid such reference.

The *Anchitherium crenidens* (as we would call it) presents especial interest in the strong crenation of the anterior border of the metaconule, offering the earliest example of this structure known, and pointing to the origin of the similar structure seen in later horses of several genera. In the *A. equinum* we have the American form nearest to the European *A. aurelianeuse.* The American (White River) *A. exoletum* Cope (not *A. cuneatum,* as stated by Scott) has superior molars of similar character.

In the Artiodactyla, the most important discovery is the presence of an ossified thyroid cartilage, and a probable rudimental clavicle in an Oreodontid, which but for these characters would be an Eporeodon. To this form Prof. Scott gives the name of Mesoreodon.

We expect thorough and intelligent work from Prof. Scott, and in this memoir we are not disappointed. It is by papers of this kind that our knowledge of the evolution of organic life is really advanced. The illustrations are every way worthy of the text.—E. D. COPE.

Von Ihring on the Fishes and Mammals of Rio Grande do Sul.[8]—These two brochures are valuable as bringing the subject of which they treat up to a later date than the papers of Hensel, who wrote in 1870–2–9. The species are not all described, and some of the notices embrace descriptions of habits, while the known distribution is given, with pretty full references to the literature. The species of

[8] Die Süsswasser Fische von Rio Grande do Sul; von Dr. H. von Ihring, 12mo, 36 pp.; Rio Grande, Jan. 1893.

Os Mammiferos do Rio Grande do Sol, pelo Dr. Herman von Ihring, 12mo, pp. 30; Rio Grande, Apl. 20, 1892.

fishes enumerated are chiefly those of the Atlantic streams. They are included in the following orders: Nematognathi, 23 sp.; Plectospondyli, 14 sp.; Holostomi, 1 sp.; Percomorphi, 8. A new Gobius is described. The Mammalia number 92 species, of which 11 are Marsupialia, 5 Edentata, 23 Glires, 16 Chiroptera, 20 Carnivora, 17 Diplarthra, 3 Quadrumana, and 2 Cetacea. An interesting feature is the number of species of Didelphyidae, of which a new species is described. The author includes without hesitation the *Felis braccata* Cope in the *F. jaguarondi*, probably because in the original description it is said to be allied to that species. As matter of fact, however, it is very little allied to that species, and has no close relationships to any other. It is remarkable for the large size and pointed outline of its ears, which are sharply bicolor on the upper surface. The mounted skin shows faint oblique bands on the sides. Its very obscure colors render it easy of concealment, which, perhaps, with its apparent rarity, accounts for its having so long escaped the observation of naturalists. Von Ihring also asserts the identity of the *Sphingurus sericeus* with the *S. villosus.* If the latter is, as generally asserted, identical with the *S. insidiosus,* the *S. sericeus* is distinct enough.—E. D. COPE.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Geologic Time indicated by the Sedimentary Rocks of North America.—Various geologists have speculated as to the age of the earth, basing their estimates on both geologic and paleontologic data. The latest contribution to the subject is from Dr. Charles Walcott. His unit is the age of the Paleozoic rocks of the Cordilleran area in western North America. A careful consideration of all the factors of denudation and deposition leads him to consider that it would have required 17,500,000 years for the deposition of the calcium and the mechanical sediments of Paleozoic time. He concludes his paper as follows:

"Taking as a basis 17,500,000 years for Paleozoic time, and the time ratios 12, 5 and 2 for Paleozoic, Mesozoic and Cenozoic (including Plistocene) respectively, the Mesozoic is given a time duration of 7,240,000 years, the Cenozoic of 2,900,000 years, and the entire series of fossiliferous sedimentary rocks of 27,650,000 years. To this there is to be added the entire period in which all of the sediments were deposited between the basal crystalline archean complex and the base of the Paleozoic. Notwithstanding the immense accumulation of mechanical sediments in this Algonkian time, with their great unconformities and the great differentiation of life at the beginning of Paleozoic time, I am not willing, with our present information, to assign a greater period than that of the Paleozoic—or 17,500,000 years. Even this seems excessive. Adding to it the time period of the fossiliferous sedimentary rocks, the result is 45,150,000 years for post-Archean time. Of the duration of Archean or pre-Algonkian time, I have no estimate based on a study of Archean strata to offer. If we assume Houghton's estimate of 33 per cent. for the Azoic period and 67 per cent. for the sedimentary rocks, Archean time would be represented by the period of 22,250,000 years.

"In estimating for the Archean, Houghton included a large series of strata that are now placed in the Algonkian of the Proterozoic of the U. S. Geol. Survey; and I think that his estimate is more than one-half too large; if so, ten million years would be a fair estimate, or rather conjecture, for Archean time.

Period.	Time Duration.
Cenozoic, including Pleistocene	2,900,000 years.
Mesozoic, ...	7,240,000 "
Paleozoic, ...	17,500,000 "
Algonkian, ...	17,500,000 "
Archean, ...	10,000,000(?) "

"It is easy to vary these results by assuming different values for area and rate of denudation, the rate of deposition of carbonate of lime, etc.; but there remains, after each attempt I have made that was based on any reliable facts of thickness, extent and character of strata, a result that does not pass below 25,000,000 to 30,000,000 as a minimim and 60,000,000 to 70,000,000 as a maximum for post-Archean geologic time. I have not referred to the rate of development of life, as that is virtually controlled by conditions of environment."

"In conclusion, geologic time is of great but not of indefinite duration. I believe that it can be measured by tens of millions, but not by single millions or hundreds of millions of years." (Journ. Geol., Vol. I, 1893.)

For the latest estimates as to the duration of the Glacial period see AMERICAN NATURALIST, March, 1894, p. 263.

The Lignites of Southern Chili.—After having made a field study of the lignitic formation in the southern part of Chili, M. Noguès reports to the Société Scientifique of Chili that these lignites certainly do not belong to the Permo-carboniferous age, as has been stated, but are of a much later age. They constitute a long band extending in a north and south direction, parallel with the Pacific Ocean, and have been dislocated by a complex series of faults. M. Noguès extended his observations to the schisto-arenaceous system, which is found around the river Bio-Bio and its affluents, La Quilacoya and the Rio Grande, and which contains beds of true anthracite coal. Paleontological evidence shows that this system corresponds with the lower beds of the lignitic formation above mentioned. Like the lignite, also, it rests unconformably upon granite rocks and the old schists of the Cordilleras, and been subjected to movements which have produced folds, swellings and anticlinals. (Actes de la Soc. Sci. du Chili, Santiago, 1894.)

Lower Cretaceous Fossils from the Black Hills of Dakota.—A recent find of cycadean trunks near Hot Springs, South Dakota, led Mr. Lester Ward to investigate that locality with the view of determining the stratigraphical position of the beds in which the fossils occur. The whole of this region consists of a series of sandstones that have been treated in the Black Hills report as the "Dakota Group." In examining a locality two miles west of Minnekahta Creek, Mr. Ward found, interstratified with the sandstones, some argillaceous shales containing a fossil flora of ferns, coniferous twigs and cycadean remains, which the author refers to the Lower Cretaceous. A further study of the plants by Prof. Fontaine and Prof. Knowlton confirms this reference. Between the horizon where these fossils were found and that of the true Dakota Group there are some hundreds of feet of sandstone and shales. (Journ. Geol., Vol. II, 1894.)

Lower Eocene Mammals near Lyons, France.—A preliminary note published by M. Charles Deperet in Comptes Rendus, April, 1894, states that a remarkably rich deposit of Eocene Vertebrates has been discovered in a quarry at Lissien, near Lyon. The author proposes to make these fossils the subject of a special memoir, but meanwhile, he gives the following brief summary of the most important facts:

"The [Perissodactyla] are the most numerous. At the head of the list stands Lophiodon, represented by three forms: one, having molars of the type named by M. Rütimeyer, *L. rhinoceroides*, but the body not quite so large. A second species resembles in form *L. isselense*, but is distinguished by its inferior premolors which have the cingulum very attenuated, recalling in this particular *L. cuvieri* of Jouey. The third form has a large premolar furnished with a rudimentary internal posterior cusp, as in *L. lautricense*.

"The American genus Hyrachyus is represented by a type that I believe to be identical with *Lophiodon cartieri* Egerkingen, and also a species of Argenton, named by M. Filhol *Hyrachyus intermedius*.

"The group [Lophiodontidae] is still more abundant. I can only mention two Paloplotheria, one large (*P. magnum* Rütimeyer), the other hardly larger than *P. codiciense* Gaud. to which it is evidently related, from the structure of the premolars.

"The genus Propalaeotherium is represented by two species, one large, indentical with *P. isselanum* Cuv.; the other small, suggesting *P. minutum* Egerkingen. A small Anchilopus seems to be related to *A. desmarestii* Gerv. Finally, there are some inferior molars which correspond to those of the ill-defined genus Lophiotherium Gerv.

"Among the Artiodactyla I have noticed the molars of *Acotherulum saturninum* Gerv., and one fine demi-mandible of a Dichobune smaller than *D. leporinum*.

"Of the group of primitive ruminants, there are only some molar teeth which seem to be identical with *Dichodon cartierii* Egerkingen.

"But the most interesting discovery among the Ungulates is a single upper molar, differing only by its smaller size from that of the animal of Egerkingen, referred by Rütimeyer to the American genus Phenacodus, under the name *P. europœus.*

"The Carnivora are represented by several types, among others a Pterodon, a primitive Viverra, with the heel of the sectorial tooth very short, as in *V. angustidens.*

"Finally, of the group of rodents, there is a fine demi-mandible of a Sciuroides, related to *Sc. siderolithicus* of Egerkingen.

"Among the undetermined species are some bones of Birds and Reptiles."

Geological News, Paleozoic.—According to Mr. C. Schuchert, a collection of fossils, comprising about thirty species, most of which are corals, demonstrate the undoubted presence of middle Devonian deposits in northern California. All the fossils studied are from limestone, nothing as yet being known from a sandstone or shale fauna.

The localities in which these collections were obtained have been examined by Mr. J. S. Diller. They are in Shasta and Siskiyou counties, California, and as the general strike of Devonian rocks near Kennett is in a line with outcrops of Hazel Creek and Soda Creek, over thirty miles away, it is thought that these rocks may be continuous. This would be an additional evidence for Mr. Diller's theory previously stated "that the axis of folding joins the Klamath Mountains to the Coast Range rather than to the Sierra." (Am. Journ. Sci., June, 1894.)

Dr. Ludwig von Ammon has published a memoir on the Stegocephali of the Rhein-pfalz known to him. These include nine species which are referred to the following genera: Branchiosaurus, 2; Apateon, 1; Anthracosaurus, 1 sp.; Archegosaurus, 2 sp.; Sclerocephalus, 2 sp.; Macromerium, n. g. von Ammon, 1 sp. The most abundant remains belong to Sclerocephalus, which includes also the the largest species. *Macromerium gumbelii* von Amm. was also a large species. The memoir (published at Munich) is in 4to, and is handsomely illustrated.

Dr. Hermann Credner published in the XXth Volume of the Abhandlungen of the Royal Saxon Society of Science a beautifully illustrated memoir on the histology of the teeth of the Paleozoic Stegocephali with plicate dentition. The investigation is confined to the genus Sclerocephalus. By removal of the osseous structure, Credner obtains beautiful casts of the vascular structures of the teeth. From this study Dr. Credner concludes that the large teeth of the Stegocephali are formed by the fusion of small teeth, such as are frequently present on the palatine and splenial bones of these animals.

Mesozoic.—The eastern boundary of the Connecticut Triassic is defined, according to Messrs. Davis and Griswold, by fault-lines—a combination of several intersecting faults, rather than a single irregular fault. The inferred faults may be divided into two sets, those of one set trending about north and south, and represented by three members; those of the other set trending northeast and northwest, and including two members. All five faults are believed to extend beyond the parts of the border line that they determine into the area of the crystalline or Triassic rocks. (Bull. Geol. Soc. Ann., Vol. V, 1894.)

In a paper in the Journal of the Philadelphia Academy, Prof. Cope describes several Pycnodont fishes from the Wichita Cretaceous bed of western Oklahoma, and a Lepidotid from the Trinity formation of Texas. He also describes part of a tarsometatarse of a bird from a probable neocene bed of Vancouver Island, under the name of *Cyphornis magnus.* He thinks it is allied to the Pelicans, but the bone is as large as the corresponding part of the American Ostrich.

A collection of Neocomian invertebrates from Kansas yields upon examination 17 new and 4 rare species. Among them is a large, apparently nereid, worm, and a well-preserved specimen of *Trochus texanus* Roem. The fossils are described and figured by Prof. F. W. Cragin in the Am. Geol., Vol. XIV, 1894. Prof. Cragin also reports from the same formation two new reptiles, *Pleisiosaurus mudgei* and *Plesiochelys belviderensis;* and three fishes hitherto undescribed, *Mesodon abrasus, (? Lamna) quinquilateralis* and *Hybodus clarkensis.* (Fifth Ann. Pub. Col. Sci. Soc., 1894.)

Cenozoic.—In the fourth part of the "Materiaux pour l'Histoire des Temps Quaternaires," MM. Gaudry and Boule describe bones of Mammalia from the caves of Gorgas in the Hautes Pyrenées. They found there *Ursus spelaeus, Crocuta maculata spelaea,* and *Canis lupus.* They embrace the opportunity of showing the graduated dentition of the Canidae from Canis through Hemicyon and Hyaenarctus, of which they give instructive figures.

M. Harlé calls attention to the discovery of fossil Hyaenas of the striped type, in the grotto of Montsaunés (Haute-Garonne). With the exception of a specimen found in the grotto of Lunel-Viel by Marcel, at the beginning of this century, there is no record of this Hyaena having ever been found in a cave in France. (Comptes-Rendus, Paris, 1894.)

Professor Dames, of Berlin, describes some remains of a Zeuglodon from Fayoum in Egypt in the Paleontological Abhandlungen for 1894. They consist of a left mandibular ramus and vertebrae of a species of medium size, which he regards as belonging to a species previously unknown. He calls it *Z. osiris*. He makes some suggestions as to the systematic of the Cetacea, proposing to divide the order primarily on the characters of the teeth. This view will not, however, probably replace the customary one, which regards as of more importance the skeletal characters of the Archæroceti, and relegates the dentition to a place of secondary value.

Dr. G. Capellini had added much to our knowledge of the extinct Cetacea of Italy in a number of illustrated papers. He describes several species of Ziphius and Mesoplodon, some of which are new; a Delphinoid with a long muzzle; a Tursiops; and the *Balœna etrusca* Cap. He also describes the remains of a new Halitherium (Metaxytherium), and a crocodile with a slender muzzle, which he refers to the genus Tomistoma, under the name of *T. calaritanum* Cap. The latter is represented by a fine skull, and some vertebræ and dermal scuta, and other important pieces.

PETROGRAPY.[1]

In a long and extensive article, Mügge[2] treats of the keratophyres of the Lennethal in Westphalia, and the neighboring regions, and their tuffs. The rocks have been considered as fragmental schists by some observers and as squeezed eruptives by others. They are known generally as the Lenneporphyries. Mügge finds that some of them are genuine eruptives and some are the tuffs of these. The massive rocks are keratophyres and quartz-keratophyres, sometimes carrying large phenocrysts of quartz and feldspar and at other times free from these. The groundmass of the keratophyres is made up of bleached biotite, sericite, feldspar, opal and glass, with traces of spherulitic structure. Schistose varieties of the quartzose varieties have become foliated through pressure, as shown by the fractured quartzes and feldspars that occur so abundantly in them, the presence of lenticular areas of quartz mosaic and the greater abundance of sericite. The most characteristic of the lenneporphyries are tuffs in which the ash structure is very well exhibit. The typical tuff structure is described by the author as due to the accumulation of glass particles with concave boundaries. These are mingled with complete and broken crystals of various minerals and often with sedimentary material. Rocks composed of intermingled volcanic and sedimentary fragmental material the author would call tuffites; when metamorphosed, tuffoids. Many of the rocks in the Lenne district have suffered dynamic metamorphism with the production of secondary quartz, feldspar, sericite, carbonates and chlorite. They are, therefore, tuffoids. The new material was formed partially from the decomposition of the rock's materials and partially with the aid of alkaline solutions originating outside of the metamorphised rocks.

Nepheline-Melilite Rocks of Texas.—Osann[3] finds a melilite nepheline basalt occurring as dykes in the Cretaceous of Uvalde Co., Texas, and nepheline basanites forming buttes and hills in the same region. The basalts are typical melilite varieties, containing phenocrysts of olivine and micro-porphyritic crystals of melilite with all the characteristic features of this mineral. Perofskite is a common

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville. Me.
[2]Neues Jahrb. f. Min., etc. B. B. viii, p. 525.
[3]Jour. Geol., Vol. I, p. 341.

accompaniment of the melilite. The basanites have an andesitic habit and since they contain more or less sanidine, they approach phonolite in composition. Hornblendes, two monoclinic augites and nepheline are common as phenocrysts, while sanidine, plagioclase and olivine are scarce. The rock of Pilot Knob, near Austin, is a porphyritic nepheline basalt.

Eleolite Syenite from Eastern Ontario.—Adams,[4] while making a geological reconnaissance in the township of Dungannon, Ontario, discovered a large area of eleolite syenite in the Laurentian of the region. The rock is notable especially for the fresh scapolite and calcite present in it and for the fact that its feldspathic constituent is an albite. Petrographically the syenite is an aggregate of the minerals above mentioned and hornblende, biotite, sodalite, garnet and zircon. The nepheline is fresh. It occurs in large quantity, and sometimes in individuals two and a half feet in length. Its composition according to Harrington is

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss	Total
43.51	33.78	.15	.16	tr	5.40	16.94	.40 =	100.34

The mica is a dark yellow-brown variety. It is present in small quantities only. Hornblende is also comparatively rare. It occurs in two varieties in different specimens. One variety has a large optical angle and a pleochroism of deep green and pale yellow tints. The other is allied to arfvedsonite. It has a small axial angle, and is pleochroic in deep bluish-green and yellowish-green tints. The scapolite is in large colorless grains that are fresh and seem to be original, and the calcite in more or less rounded individuals, often included within the other constituents. The feldspar is largely albite. A small quanitity orothoclase occurs, especially associated with the sodalite. This orothoclase is thought to be secondary.[5] An analysis of the sodalite gave:

SiO_2	Al_2O_3	FeO	Na_2O	K_2O	Cl	SO_3	H_2O	Ins.	Total
36.58	31.05	.20	24.81	.79	6.88	.12	.27	.80 =	101.50

O = Cl 1.55 = 99.95.

Petrographical News.—The basic dyke material at Hamburg, Sussex Co., N. J., which was thought to be leucite tephrite by Hus-

[4]Amer. Jour. Sci., 1894, XLVIII, p. 10.

[5]Cf. also Geol. Surv. of Can., Vol. VI, Pt. J.

sak[6] and declared by Kemp[7] to be an aggregate of pyroxene, biotite and analcite has been examined at another place by the last named geologist. It has been found by him[8] to contain leucite. Hussak's determination is thus confirmed. The rock is a leucite tephrite.

A spherical granite from a boulder discovered on Qonochontogue Beach in Southwestern Rhode Island is described by Kemp[9] as a coarse granitite, with nodules from two to three inches in diameter scattered through it. These consist of a center of coarse plagioclase with a little quartz, surrounded by a concentric zone of biotite and magnetite, and a peripheral one of radiating plagioclase, whose laths end sharply against the granite matrix. The author explains the nodules as centers of crystallization.

The rocks that have for the past few years been called muscovadite by the Minnesota Geological Survey have recently been examined by Grant,[10] who finds among them several distinct rock types. Some of muscovadites are fine grained aggregates of pyroxene, quartz and feldspar, containing in their midst large flakes of biotite. Others are composed of quartz and biotite, etc. These are considered as contact rocks. A second class of the muscovadite comprises granulitic gab-bros and norites.

The siliceous oolite of State College, Pa., is composed of radial spherules of fibrous chalcedony forming bands around fragments and rounded grains of quartz. Between the spherules are bundles of chalcedony fibres placed normal to the surface of the spherules nearest them, and intermingled with these are granular chalcedony and quartz. An oolite from the Tertiary beds of New Jersey is an aggregate of sphero-crystals of chalcedony, usually without nuclei. Occasionally a cone of fine grained quartz is to be seen, but this is rare. The matrix between the spherules is partly chalcedony and partly quartz.[11]

Duparc and Mrazec[12] refer very briefly to the mineralogical composition of an occurrence of Serpentine at Geisspfad in the Swiss Alps. The rock now contains hornblende, chromiferous diopside, diallage and some secondary substances in addition to serpentine. The rock was probably originally a Lherzolite.

[6]Amer. Naturalist, 1893, p. 274.
[7]Ib. 1893, p. 563.
[8]Amer. Jour. Sci , XLVII, 1894, p. 333.
[9]Trans. N. Y. Acad. Sci., XIII, 1894, p. 140.
[10]21st Ann. Rep. Minn. Survey, p. 147.
[11]E. O. Hovey: Bull. Geol. Soc. Amer., Vol. 5, p. 627.
[12]Bull. Soc. Franc d. Min., XVI, p. 210.

Phillips[13] has analyzed specimens of Pele's hair (I) and of lava stalagmites (II) from the caves of Kilauea, Hawaii, with these results:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	P_2O_5	CaO	MgO	Na_2O	K_2O	Total
50.76	14.75	2.89	9.85	.41	.26	11.05	6.54	2.70	.88	= 100.09
51.77	15.66	8.46	6.54	.82		9.56	4.95	2.17	.96	= 100.89

Lacroix[14] finds specimens of nepheline basalt from Saint Sandoux, Puy-de-Dom, France, in an old collection preserved in the College of France.

Some of the trap dykes of the Lake Champlain region are camptonites. Others consist of monchiquite, fourchite or bostonite. All are described by Kemp and Marsters[15] in a recent Bulletin of the Survey

[13]Amer. Jour. Sci., XLVII, p. 473.
[14]Bull. Soc. Franc d. Min., XVII, p. 43.
[15]Bull. U. S. Geol. Surv., No. 107.

BOTANY.[1]

Notes on a Few Shrubs of Northern Nebraska.—Of 50 shrubs that grow in the northern tier of counties west of Antelope County, some few have interested the writer and may prove of general interest. The observations extend over a period of six years. They are likely to be continued with equal profit in the years to come. The order followed is that of Professor Bessey's "Native Trees and Shrubs of Nebraska."

The only shrub representing the Coniferae is *Juniperus communis* L. I have seen it only in Hat Creek Basin, Sioux County. There it grows in prostrate ascending form, exactly like the juniper of Connecticut, in dry pastures. I have no specimen of the latter, but suppose it to be var. *alpina*.

Corylus americana Walt. is chiefly remarkable for its absence in this region. I have found it only in Cherry County, ten miles east of Valentine and 20 miles southwest on the Niobrara and its tributaries. It is flourishing and abundant where it occurs. Its lack of distribution may be partly accounted for by the late frosts of this high altitude (2600 ft.), which, as this year, destroy the flowers.

Salix tristis Ait. is very common over the sand-hill portion of Cherry County, also in Brown and Holt Counties. When it was sent to Mr. M. S. Bebb from Long Pine, Brown County, he stated that that was its western limit, so far as he knew. It is probable that Cherry County furnishes the limit sixty miles further west. Gray's Manual gives the height "1–1½ ft. high." It grows 5 feet high at Long Pine, in the brush.

Salix cordata is represented by var. *angustata* Anders., though the State claims var. *vestita* Anders. in the other portions. Mr. Bebb (Coulter's Man.) says: "It is altogether incredible, however, that any form of *S. cordata* ever attains tree-like size." I have a specimen at Ewing, Holt County, about twenty feet high and eight inches in diameter—a pretty sizable shrub! I shall measure it and take specimens this season. I will state, however, that it retains its shrubby character by branching ten or fifteen times just above this diameter, some of the branches being five or six inches through.

[1]Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska,

Rhus toxicodendron L. As an instance of adaptability to environment, this species is noteworthy. It is very common on the sandy prairie of this region, perfectly upright, seldom over one foot high, with no tendency to creep, fruiting freely. Even in the brush you will seldom see it as a climber. It deserves more attention than most collectors would care to give it.

The wild crab is represented in these counties by *Pyrus ioensis* (Wood) Bailey. It has been commonly called, heretofore, *P. coronaria* L., but is much too white-wooly. It forms large patches covering several acres in extent, and, when not browsed by cattle, produces useful fruit. Its western range, so far, is northern Brown County.

Crataegus coccinea L. also represents the family with its beautiful scarlet clusters of edible fruit. While stray trees have been found in Cherry County, probably coming south from Rosebud Agency, where it is said to be common, I have not found it common west of Holt County.

Amorpha microphylla Pursh. is a new shrub in Nebraska. I found it last year (1893) on the gumbo hills of Holt and Boyd Counties, very common, but quite confined to that soil. It was reported also from another section of the State.

Up to the present time, no species of *Oenothera* has been reported as shrubby so far as my reading extends. I have seen indications in past years that caused me to suspect *Oenothera serrulata* Nutt of having the character, to some extent. This year, I have abundant confirmaion. Here at Valentine. after a dry, hard winter that has killed whole timber claims of forest trees by freezing dry, a plant of this species has bloomed vigorously on shoots six inches long, starting from last year's stock five to six inches above the ground. The situation was fully exposed to all the rigors of the season. I have found several other plants sprouting vigorously two and three inches above ground. It shows about the same degree of hardiness as half the plants of *Amorpha canescens* Nutt., and quite as much as *Gutierrezia euthamiae* Torr. & Gray in this climate, both of which have long been classed as shrubs.

Valentine, Neb. —J. M. Bates.

Botany at Brooklyn.—The recent scientific meetings in Brooklyn brought out a good number of botanists, whose papers and discussions touched upon nearly all parts of the subject of Botany, from Bacteriology to Paleobotany. That all were of a high order of merit could not be truthfully affirmed, but that all were creditable, and some of unusual interest is true. The botanists of the country have no reason for feeling ashamed of their work as represented in these meetings.

In the Society for the Promotion of Agricultural Science nearly every paper dealt with some question more or less botanical. Here of course, the treatment was economic rather than strictly scientific, and yet in every case there was much of interest to the botanist. Thus there were papers on "The Vitality of the Seeds of Red Clover" (*Beal*); "The Russian Thistle in Nebraska" (*Bessey*); "A possible Relation between Blights and Exceptional Weather" (*Halsted*); "The Growth of Lettuce as affected by Physical Properties of the Soil" (*Galloway*); etc., etc.

The Botanical Club of the Association held several interesting sessions, and took active part in a delightful excursion by boat to Cold Spring Harbor on the north shore of Long Island. Among the notes presented before the club were the following: "The Prothallium of *Marsilia vestita*" (*Bessey*); "Notes on Oat-Smut" (*Jones*); "The use of Formalin as a Preservative Agent" (*Galloway*); "Sporangial trichomes on Ferns" (*Durand*); "The Significance of Stipules from the standpoint of Paleobotany" (*Hollick*); "A Plea for the better Pronunciation of Botanical Names" (*Bessey*); "A Species of *Olpidium* parasitic on *Spirogyra*" (*Durand*); "A method of making pure cultures of Fungi" (*Smith*); etc., etc.

A Committee on the pronunciation of Botanical Names was appointed consisting of Charles E. Bessey, N. L. Britton and E. L. Greene. The officers for the next year are Douglas H. Campbell, of Palo Alto, California, and Frederick C. Newcomb, of Ann Arbor, Michigan.

Twenty-six papers were read before Section G, beginning with the opening address by Vice-President Underwood, upon "The Evolution of the Hepaticæ." In this the speaker traced in a masterly way the evolution of the several groups of the liverworts, pointing out their mutual relationships, as well as their affinities with higher and lower plants.

The other papers were as follows:

B. T. Galloway, "The Growth of Radishes as affected by the Size and Weight of the Seed"; Katherine E. Golden, "The Movement of Gases in Rhizomes"; A. D. Hopkins, "Some Interesting Conditions in Wood resulting from the attacks of Insects and Woodpeckers"; W. J. Beal, "The Sugar Maples of Central Michigan"; John M. Coulter, "Some Affinities among Cactaceæ"; Charles E. Bessey, "Simplification and Degeneration"; Frederick C. Newcomb, "Regulatory Growth of Mechanical Tissue"; Charles E. Bessey, "Further Studies of the Relationship and Arrangement of the Flowering Plants"; Erwin F. Smith, "The Watermelon Disease of the South"; L. H. Bailey, "The Relation of Age of Type to Variability"; L. H. Bailey, "The Struggle for Existence under Cultivation"; "George F. Atkinson, "Relation between the Functions of the Vegetative and Reproductive Leaves of *Onoclea*"; H. H. Rusby, "*Lophopappus*, a new genus of Mutisiaceous Compositæ and *Fluckigeria*, a new genus of *Gesneriaceæ*"; George F. Atkinson, "On the Swarmspores of *Pythium* and *Ceratiomyxa*"; Elizabeth G. Britton, "A Revision of the genus *Scouleria*"; B. G. Wilder, "Evidence as to the former existence of large trees on Nantucket Island"; N. L. Britton, "Notes on Primary Foliage and the Leaf-scars in *Pinus rigida*"; Byron D. Halsted, "Notes upon *Chalara paradoxa*"; Elizabeth G. Britton, "A Hybrid among the Mosses"; Byron D. Halsted, "Notes upon a Root-rot of Beets"; N. L. Britton, "On *Torreya* as a Generic Name"; Elizabeth G. Britton, "Some Notes on the genus *Encalypta*"; Jed. Hotchkiss, "The Growth of Forest-trees illustrated from marked corners 107 years old"; Mrs. F. W. Patterson, "Species of *Taphrina* parasitic upon Populus"; Albert Mann, "Products of Metamorphosis and Monstrosities" (by title only).

Reports of progress were made by several of the Committees appointed last year, and they were continued for further work.

The Committee of the charter members of the Botanical Society of America held several meetings persuant to a call of the Chairman, Dr. Trelease, and perfected the organization of the Society. Much time was spent in discussing the details of the organization, and in perfecting plans for work. The officers for the ensuing year are as follows: President, William Trelease, St. Louis; Vice-President, N. L. Britton, New York; Secretary, Charles R. Barnes, Madison, Wis.; Treasurer, John D. Smith, Baltimore.

Provision was made for a meeting sometime during the summer of 1895, the time and place to be announced later by the Executive Committee.

CHARLES E. BESSEY.

ZOOLOGY.

On the Vertical Distribution of Pelagic Crustacea in Green Lake, Wisconsin.—Green Lake is the deepest body of water in the State of Wisconsin, having a maximum depth of about 60 meters. Because of its great depth it has not only the litoral and pelagic faunæ of the shallower bodies of water, but also the true abyssal fauna which is characteristic of the deeper lakes. In fact, the crustacean fauna of Green Lake is almost identical with that of the great lakes.

In the deeper waters of Green Lake are found fifteen species of crustacea. Of these, twelve may be fairly considered as belonging peculiarly to the deep water fauna. Most of these can be captured in very large numbers at night by means of the skimming net. During the day, very few are found at the surface, some few never come to the surface, and are only obtained by dredging in the deep water.

Of course, an open dredge, dropped from the surface to the bottom and then hauled up, will collect from all depths. After a little experience, the collector has no difficulty in distinguishing between pelagic and abyssal species, and can even draw inferences, with a reasonable degree of accuracy, in regard to the general vertical distribution of species. So far as I know, however, very little exact work has been done to determine the vertical limits of the various species. By means of dredges which could be closed at any required depth, it has been found that in the deep sea there is a surface fauna and a deepwater fauna, but that the immediate intermediate region is barren of animal life. According to Agassiz, the surface fauna extends to the depth of 200 fathoms, and the bottom fauna is limited to about 60 fathoms.

Is there a similar condition in the waters of our lakes? With a view to answering this question, I made some preliminary collections in the summer of 1893.

I used, for the collections, a vertical dredge, so constructed that it could be closed at any desired depth. The collections upon which this paper is based were made in the latter part of August, at all hours between five o'clock in the morning and nine o'clock at night. Each series included collections for every five meters in depth. Of course, until a much larger number of collections is made, and at different seasons of the year, no final conclusions can be drawn. But the results thus far are interesting, and I think later collections are not likely to modify, to any great extent, the conclusions I have formed.

The results were a little disappointing to me at first, I must confess. I had made up my mind that I should find the three regions characteristic of the deep sea—the pelagic, intermediate and abyssal. It was rather discouraging, then, when I found material in my dredge from all depths. Not only that, but when I began to examine the collections under the microscope, I found certain species, which I had considered peculiar to the surface—like *Diaptomus minutus*—occurring all the way from the surface to the mud of the bottom. The barren intermediate zone, then, does not exist in Green Lake. It is true, however, that the numbers of individuals are less at intermediate depths than near the surface or near the bottom, and that some species are vastly more numerous in the upper zone, while others are almost entirely confined to the lower.

I counted the number of individuals in each haul, and after reducing the numbers to percentages, tabulated the results.

I will give briefly the conclusions I reached in regard to those species which are found most commonly.

The species which is found in the greatest numbers is *Diaptomus minutus*. In one haul this was associated with *D. sicilis* (a somewhat rare form in Green Lake), and in my computation I did not separate the two, as their habits are identical. On the average, 46 per cent of this species is within five meters of the surface, and 59.4 per cent within ten meters. Within ten meters of the bottom are only 7.37 per cent. It is evident that more than one-half of the individuals of these species are found within ten meters of the surface, and that from that point to the bottom, the numbers steadily decrease.

Daphnella is more exclusively pelagic—79 per cent being found within ten meters of the surface, and only 5.6 per cent at the bottom.

Epischura is still more distinctly pelagic—81 per cent being in the first ten meters, and 3.3 per cent in the last ten.

Leptodora, *Bosmina* and *Cyclops fluviatilis* are also found much more abundantly near the surface. *Leptodora* rarely goes below fifteen meters.

Daphnia kahlbergiensis seems somewhat erratic in its distribution. On the average, nearly 43 per cent are found within the first ten meters, but nearly 25 per cent are found in the last ten. Generally speaking, they appear more numerous near the surface and the bottom, but less so at intermediate depths. But they may occur at all depths, and sometimes quite numerously in the intermediate region.

Limnocalanus macrurus rarely, if ever, comes to the surface, and is found most abundantly within 20 meters of the bottom. Nordqvist states that he found *L. macrurus* in Finland, in June, most abundant at twelve meters below the surface, where the total depth was 25 to 26 meters.

Pontoporeia and *Mysis* live at the bottom, and belong to the true abyssal fauna.

In regard to the diurnal migrations of the pelagic species, I found it difficult to fix any exact limits. As has been before stated, they come to the surface at night. In the daytime, few of them go below ten meters. *Daphnia kahlbergiensis,* however, seems to be an exception, for, apparently, its migrations are limited only by the depth of the lake, and sometimes from 40 to 80 per cent are in the last ten meters.

As a result of these collections, I was led to doubt the value of "Plankton" determinations, at least so far as crustacea are concerned. All such determinations must start with the assumption that the life of the deeper waters is distributed uniformly. If this were true, successive hauls in the same depth of water would contain approximately the same number of individuals. This was far from the case in my collections. The position in the successive collections varied only as the boat drifted very slowly; yet the number of *Diaptomi* varied from 291 to 2,966; *Daphnella* from 0 to 122; *Daphnia kahlbergiensis* from 6 to 103, and *Epischura* from 7 to 105. It seems probable that they are present in swarms, and that the positions of the swarms are continually changing.

Zacharias, in his last report from the biological Station at Plön, has reached the same conclusions, not only in regard to the crustacea, but also the other pelagic organisms. "Plankton" determinations, in order to have much value, must be almost infinite in number.

Beginning with the fall of 1894, systematic work of a more detailed character will be carried on at Green Lake, as the Trustees of Ripon College have made an appropriation for the purpose.

—C. Dwight Marsh, Ripon College, Wisconsin.

Rotatoria of the Great Lakes.—The Michigan Fish Commission have issued, as Bulletin No. 3, a list of the Rotatoria found in Lake St. Clair and some of the inland lakes of Michigan, prepared by Mr. H. S. Jennings. Of the 122 rotifers named in the list, 6 are here described and figured for the first time. Strongly swimming forms, commonly found in the open water, are designated pelagic; those found among the vegetation of the shores and bottom, littoral. Of the former, 20 were observed in Lake St. Clair. In the case of the inland lakes, collections were made from the shore only. The most abundant pelagic species are *Polyarthra platyptera* Ehrbg., *Anuraea cochlearis* Gosse, and *Asplanchna priodonta* Gosse, which agree, in this respect, with the condition found in European lakes.

The Internal Anatomy and Relationship of Pauropus.—According to Peter Schmidt, whose preliminary paper appeared in the *Zoologischer Anzeiger*,[1] the internal anatomy of *Pauropus* allies it most closely with *Polyxenus* among the Diplopoda. The absence of trachea, of malpighian tubes and of a circulatory system, together with the presence of a rather complicated genital apparatus in the male, seem to show that it is very degenerate. That it belongs along with the Diplopoda—a fact that has been questioned—the presence of the ovary below the intestine, of the genital openings in the third body segment behind the second pair of legs, and of only two pairs of oval appendages, abundantly testify. The biramose antennæ may possibly be explained by a comparison with the sense papillæ at the end of the terminal joint of the Diplopod antenna, the more readily, too, since, according to Schmidt, the distal portions of the rami, the geisseln of Latzel appear to be finely ringed and not segmented.

Several peculiarities are interesting. The mid-gut is without a *muscularis* and its epithelial cells are filled with rhomboid crystals with double refractive powers. The supra- and sub-œsophageal and the first body ganglia are fused into one mass which is pierced by a very short fore-gut. The small processes on the first segment represent rudimentary legs and possibly function in respiration like the abdominal sacs of Thysanura, Symphyla and certain Diplopods. The sense organ of the antennæ, the *globulus* of Latzel, consists of an outer and inner capsule with the intervening space filled with a fluid. The whole is surrounded by ten or twelve bristles while the nerve passes into the inner capsule and expands into a nail-like head. (Fig: 1.)

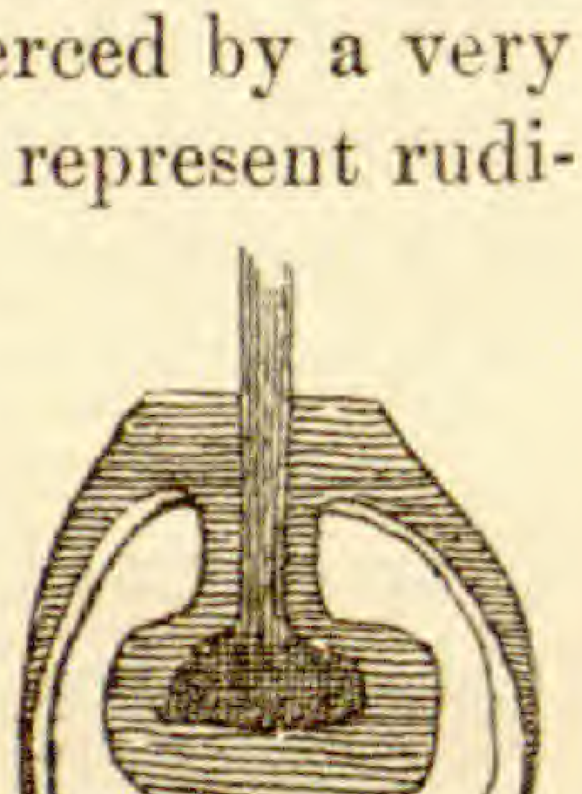


Fig. 1.

The female genital apparatus consists of an unpaired ovary lying, beneath the intestine, an unpaired receptaculum seminis and an oviduct opening to the exterior by an unpaired opening to the one side of the median line in the third segment. In the male there is an unpaired testis above the intestine, a complicated pair of ducts, a pair of seminal

[1] Zur Kenntniss des inneren Baues des Pauropus huxleyi Lubb. Zool. Anz., XVII, 189.

glands, and a pair of genital openings. Near the middle the testis communicates with the two small vasa deferentia that open into two

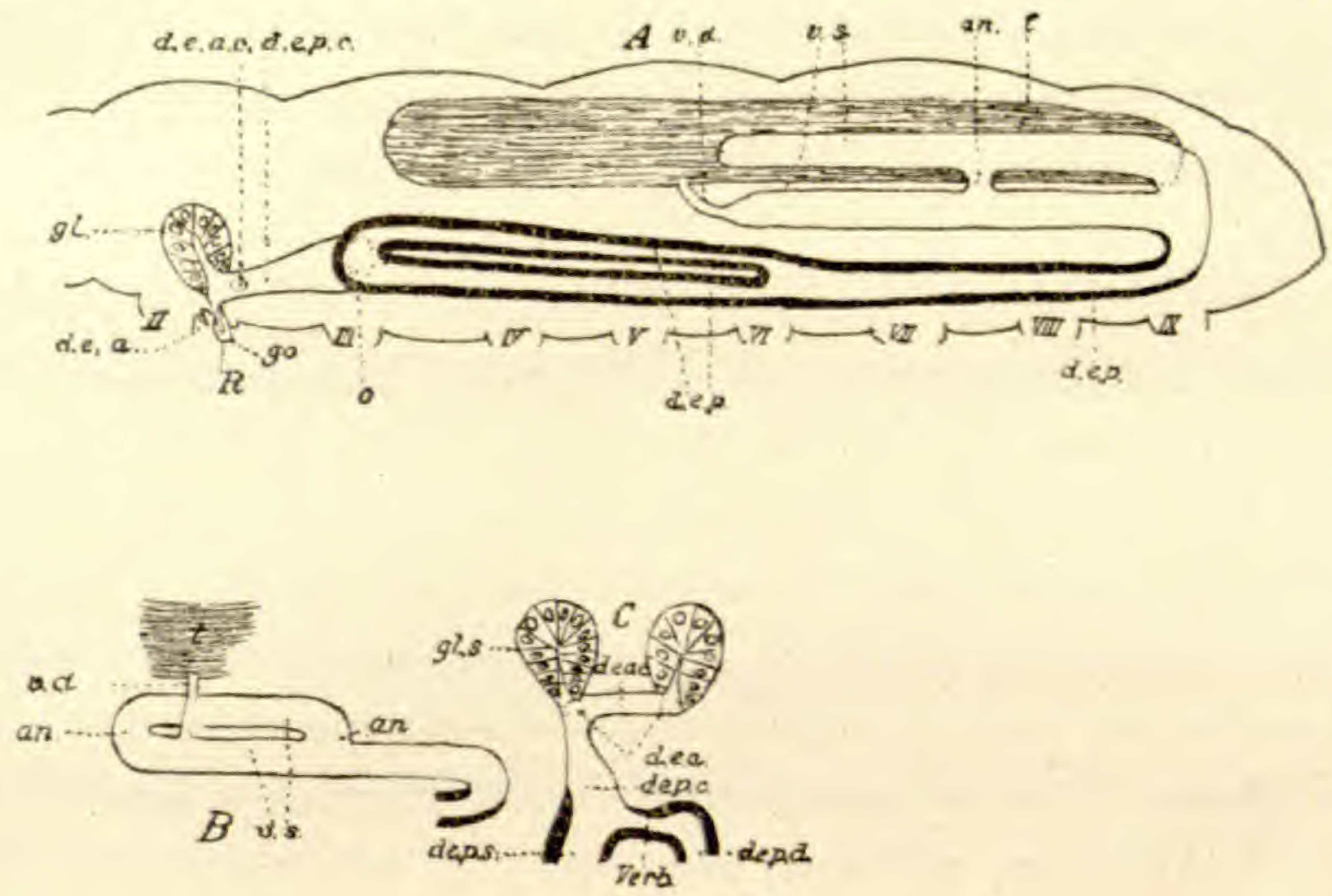


Fig. 2.

Diagrammatic representation of the male genital organs of *Pauropus huxleyi* Lubb. A. From the left side, II–IX the coxæ of the II–IX pairs of legs; t, testis; v.d, *vas deferens;* v.s., *vesiculæ seminales;* an, anastomosis; d.e.p., *Ductus ejaculatorius posterior;* o, opening between the d.e.p.; d.e.p.c., *Duct. ejac. post. communis;* d.e.a.c., *Duct. ejac. anterior communis;* gl., *glandula accessoria;* d.e.a., *Duct. ejac. anterior;* go, genital opening; R, penis.

B. From the right, somewhat shortened.

C. The anterior part from above.

large tubes which are bent upon themselves. These open posteriorly into two ducts that run forward beneath the intestine. The anterior half of each of them is double. In the fourth segment they unite into a short tube on the side of the body. This communicates with a transverse tube into which the seminal vesicles open, and which opens to the exterior by two openings.

The spermatozoa are pod-like. —F. C. Kenyon.

Thysanura from the Cave of Central France.—M. R. Moniez describes three new species of Thysanoures from the grotto of Dargilan in the Department of Lozére, France. The first, *Campodea dargilani,* appears to be the third of a series of forms adapted progressively for a life in darkness. That is, the characters of *C. staphylinus,* the type of the genus living in open air, are more accentuated in *C. coopei,* a cave form, and are carried to an extreme in *C. dargilani.* The second, *Sira cavernarum,* is white, covered with transparent scales, and is entirely blind. The third, *Lipura cirrigera,* is characterized by tufts of 6 or 7 cirrhi at the base of the second joint of the attennæ. These cirrhi are spaced at their insertion and recurved. These organs are present in the other Lipurae, but in so rudimentary a state that they have heretofore escaped observation. (Revue Biol. de Nord., Dec., 1893).

Result of a Comparison of Antipodal Faunas.—Prof. Gill's paper on a comparison of the piscine fauna of the British island with that of the New Zealand waters contains some important deductions. An analysis of a tabulated list of the families of these two regions shows that twenty-five families are represented in the New Zealand seas and not in the British; of these eleven are peculiar to the Southern Hemisphere; four are represented in the Northern Pacific, but not in the North Atlantic; and ten, although not represented in the British seas, have quite a general distribution.

Of the fresh-water species, those characteristic of the Northern Hemisphere are, with the exception of the Argentinidae, entirely unrepresented in the Southern, while the Antipodal types are wanting in the Northern zones.

According to Professor Hutton, the New Zealand Fishes belong to no less than six distinct geographical realms: Notalian, Antarctalian, Pelagalian, Bassalian, Tropicalian and Ornithogæan. A consideration of these various elements and comparison of them with those of other regions leads Dr. Gill to the following conclusions:

"The main marine fauna of New Zealand is derived from representatives of the general stock which has become developed in the great Notalian realm. The number of species apparently peculiar to the province, and, therefore, modified from other or earlier representatives, indicates a long period of isolation in accordance with its distance from the nearest continents and the depth of the intervening ocean. The percentage of such peculiar species seems to entitle it to rank as a distinct region (or subregion) rather than as an integral portion of the Notalian region composed of the isothermal portions of Australia and Tasmania, as has been generally done. A more extended study and actual comparison of the species of the two regions may, however, compel a reconsideration of this view."

"The fresh-water fishes must have been derived from the same common source as those of the isothermal portions of Australia (of course, including Tasmania) and South America. There may not have been a continuity of land at any one time between South America, Australia and New Zealand, but, at more remote period in the past, it is, at least, possible that there was a region in which the Galaxiids and Haplochitonids were developed, and subsequently representatives of those families might have found their way into the regions where they now abound."

In the discussion of the possibilities of the origin of the present types of the fresh-water fishes of New Zealand, it appears that Dr. Gill is of the opinion that "community in type must be the expression of community of origin, and the presence of fishes of long-established fresh-water types must imply continuity or at least contiguity of the lands in the midst of which they occur at some time or other." He then adds: "We may be permitted to postulate (fishes being congeneric in New Zealand, Australia and South America), that there existed some terrestrial passageway between the several regions at a time as late as the close of the Mesozoic period. The evidence of such a connection afforded by congeneric fishes is fortified by analogous representatives among insects, mollusks, and even amphibians. The separation of the several areas must, however, have occurred little later than the early Tertiary, inasmuch as the salt-water fishes of corresponding isotherms found along the coasts of the now widely separated lands are to such a large extent specifically different. In general, change seems to take place more rapidly among marine animals than fresh-water representatives of the same class." (Fifth Mém., Vol. VI, Natl. Acad. Sciences.)

The Carotid, Thymus, and Thyroid Glands form the subject of a rather lengthy paper by A. Prenant.[2] He had a good series of embryos, and studied carefully the histological changes during development. According to him the carotid gland originates from the third entodermal branchial pouch, and at first becomes closely connected with the primitive carotid artery, but later loses this connection and becomes united with the head of the thymus. In regard to the lymphoid transformation of the thymus, he says that in embryos, from 25 and 85 mm. in length, there appear small nuclear elements among the primitive epithelial cells, which stain deeply and are comparable to lymphocytes. The thymus in embryos of 85 mm. and upwards begins to differentiate itself into an outer cortical portion and an inner medulary portion. The latter is clearer, looser in texture and poorer in lympathic elements than the cortical portions. This further becomes differentiated into a peripheral and an inner portion. The former stains less, is richer in karyokinetic figures than the latter. It

[2]Contribution à l'etude de développement organique et histologique des Thymus de la glande thyroid, et de la glande carotidienne. A. Prenant, La Cellule, X.

is doubtless a germ of proliferation. Nothing surrounding the organ authorizes the supposition that this is a muscular connective tissue which produces the lymphocytes that fill the organ. It is probable that epithelial cells after multiplying actively by mitosis, give rise to the lymphocytes by simple division (stenose). For large nuclei with small buds frequently occur and small nuclear bodies may be seen by the side of large nuclei and within the same. This mode of division is more common in the earlier stages. In older embryos the lymphocytes are formed karyokinetically. The epithelial cells that probably persist even in the completely developed organ he compares with the cells forming the matrix of the testis and the coveys of lymphocytes arising from them with the seminal elements.

The lateral portions of the thyroid develop from the fourth entodermal branchial pouch, which is forked. From the angle of this there grows up an organ that in structure and appearance is comparable with the carotid gland. This he calls the *glande thyroidienne.* It finally comes to lie outside of the vascular-connective hilum of the thyroid. During development an anfractuous cavity appears in the thyroid and is prolonged in every direction by deep diverticula. At first its walls are stratified and then simple. The superficial cells disappear after a transformation comparable to that which occurs in the internal assizes of the epithelium of the æsophagus. The wall produces around itself a cellular reticulate structure of dense aspect, which later disappears. Whether the lateral gland gives rise to buds that become confusingly anastomosed and eventually transformed into thyroid vesicles, or whether the lobes of the median gland solder themselves to the tissue of the lateral gland, it is impossible to say.

There is very little of a comparative nature in the paper beyond an attempt to introduce a formula to represent the number and position of the glands in invertebrata. This is not nearly as readily understood as a simple diagramatic figure; moreover, it is entirely unnecessary.

Of possible interest in connection with the work of Prenant is a short paper by J. Beard on the Development and Probable Function of the Thymus.[3] In Raja he declares that the epithelial nature and appearance of the cells composing the gland is lost very soon after their formation. Their nuclei stain intensely, and the cell-body, i. e., the protoplasm, is very scant from the start. It is clear that there is no inwandering of lymph cells, but that these elements are the direct offspring of the epithelium of the gill cleft.

[3]Anat. Anz., IX, p. 476.

As to the function of the gland, bearing in mind the observations of Stöhr and Killian on the tonsils, he concludes that the thymus exists in fishes for the protection of the gills from bacteria, etc., by the formation of leucocytes. With the disappearance of the gills of fishes and perrennibranchiate amphibians, the gland undergoes a restriction in the area of its formation and its functions are transformed to other organs. In the higher vertebrates this protective function is transferred to the tonsils at the opening of the respiratory passage.

—F. C. KENYON.

ENTOMOLOGY.[1]

On the larvæ and pupæ of Hololepta and Pyrochroa.— Aside from those of direct economic importance, the larvæ of North American Coleoptera have received too little attention from entomologists, and many of our common beetles are quite unknown in their early stages, while others have received passing notice in text-books or agricultural reports, with here and there a figure, and sometimes a few words of description, more or less vague. Many of the injurious ones have been, however, investigated in the most thorough manner by our best students of insect life.

The two species treated of in the present paper have not before been given space in our literature beyond, in one case, a short note. It has, therefore, been thought fit to furnish detailed descriptions and figures for the use of those who may wish to indentify specimens in their possession.

HOLOLEPTA FOSSULARIS Say. Plate XXVI, figs. 1, a, b, c, d.

Color of larva nearly white, head chestnut, prothorax with a triangular space, occupying most of the upper surface, a little lighter than the head. Back with a dark line for the greater portion of the length where the viscera show through.

Form elongate, somewhat flattened; length 17.5 mm.

Head castaneous, quadrate, broader than long; above strongly flattened, with four impressed lines on the front and an impressed space near the base of each antenna, from which a line of punctures runs to the base. Anterior margin produced, truncate in front, and with a lobe over each mandible. Beneath, less flattened, with a broad, deep impressed space on the gular region, extending in the form of a narrow groove to the base.

Antennæ arising from the sides of the head, immediately behind the base of the mandibles, four-jointed, the first joint very short, sunken, the second long, the third shorter, subtriangular, with three papillæ at end, fourth joint again shorter, elongate oval. There are, apparently, no bristles, except two short and inconspicuous ones at the tip of the last joint.

Eyes are, apparently, altogether wanting.

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

Mandibles stout, rather long, curved, with a strong, rounded tooth before the middle.

Maxillæ composed of a long, stout basal piece, heavily bristled, especially on the inside, a shorter second joint, which bears a one-jointed appendix, tipped by a bristle, on the outside; third, fourth and fifth joints subequal, the last two, however, a trifle longer and more slender.

Mentum borne on a tuberculiform base, elongate, wider near the tip, palpi two-jointed terminal joint longer.

Prothorax corneous, transverse, sides and base somewhat rounded, apex nearly truncate, median line distinct, rather deep, a deeper impression each side external to which is a vague foveate impression. Beneath with two deeply impressed lines strongly convergent anteriorly, posterior to which are two foveæ.

Meso- and metathorax much shorter than the prothorax, membranous with a long, crescentic, horny scute at middle, both above and below, and smaller ones at sides. Each of these segments bears a lateral bristle.

Abdomen of nine segments, which are protuberant near the middle of the sides and transversely wrinkled, armed with two lateral and one ventro-lateral bristle on each side. Each segment except the last is granulato-spinose on the scutes of the under surface; the last bears two bi-articulate appendages, each armed with five bristles, as shown in the figure. The anus is inferior.

Spiracles in nine pairs, the first situated beneath the anterior mesothoracic angles, the others in segments 1 to 8 of the abdomen, near the anterior margins and somewhat ventro-laterally.

Legs small, weak, slender. The coxæ are rounded, imperfectly chitinized, the trochanter distinctly marked, femur somewhat creased on the edges, tibiæ shorter, slightly bristled, claw single with two short bristles at about the middle of the length.

The pupa is white, 10 mm. in length and of the same general shape as the beetle, but with a more pointed abdomen; the meso-metasternal area is coarsely punctured.

Nearly full-grown larvæ of this species were found under the bark of an old cottonwood log near the end of March, between the thin layers next to the wood. In captivity they fed upon the pupæ of Diptera taken in the same situation. After several days the largest one constructed a case of small pieces of bark; the dimensions were 14 by 7 mm., the outside rough, but the inside perfectly smooth. In this case the change to a pupa took place after a rest of above a week.

PYROCHROA FLABELATA Fabr. Plate XXVI, figs. 2, a, b, c, d, e, f.

Color of full-grown larva clear, light yellow, the head, especially the mouth parts, and the terminal processes castaneous.

Form elongate, much depressed, sides sub-parallel, slightly broader behind, segments with dorso- and ventro-lateral bristles. Terminal segment corneous with two stout processes directed upward and backward. Length 34.5 mm.

Head corneous, free, the sides strongly rounded, front produced at middle, labrum distinct, tip sinuate more prominent at middle, anterior margin strongly bristled, suture very slightly sinuate. Top of head with a depressed space surrounding a large tubercle, anteriorly with transverse striations and two tolerably distinct longitudinal lines.

Eyes consist of four ocelli on each side of the head, just posterior to the antennæ. The three anterior ones in each group are arranged in a slightly oblique curved line, back of the middle of which the fourth is placed.

Antennæ lateral, situated behind the base of the mandibles, four-jointed, the first joint stout, short, the second long, third and fourth subequal, together somewhat longer than the second. The fourth joint is much more slender than the third, and all are strongly bristled.

Mandibles extremely stout and heavy, deep, the tip emarginate, internally strongly toothed, as shown by the drawing.

Maxillæ large, strong corneous; the lobe is sinuate on the inner margin and armed with bristles, those near the end arrayed in rows, the inner apical ones recurved. The palpi are stout, the second and third joints about equal and separately longer than the first; all are bristly.

Mentum of the form shown in fig. 2 f. The shaded portion is thicker and more perfectly chitinized than the remainder, and has every appearance of being divided by sutures from the underlying and superimposed pieces.

Prothorax about equal in width to the head, the sides nearly straight, except at the angles, where they are abruptly directed inwards. Median line distinct with a fovea each side anterior to the middle and crossed in front of these by a fine transverse line. Beneath with two strongly impressed lines which, originating between the coxæ, diverge strongly in front and attain the margin near the anterior angles, the triangular space thus enclosed being also bistriate at middle.

Mesothorax broadest near the base, more convex than the prothorax, with distinct median line, and, on each side of this, a vague double fovea, slightly behind the middle. Anteriorly there is a fine transverse line crossing the median one at right angles. Beneath is a smooth subquadrate space, usually bounded at sides and behind (except for a short distance at middle) by broad, deeply impressed lines.

Metathorax similar, but the lines beneath effect a junction at the middle.

Abdomen with the first seven segments quite similar in form, subangulate at the sides, median dorsal and anterior transverse lines distinct, the former more so. Beneath is a very well marked submarginal plica. The eighth segment is larger, longer, more perfectly chitinized, sides slightly rounded. Median dorsal line very distinct, with a less distinct oblique one on each side. Beneath there is an impressed median line which has posteriorly a slightly elevated carina on each side; external to this is a sinuous broader line each side, and outside of this again a very deep impression which extends from a point distant about one-fifth from the basal lateral margin to the posterior angle of the segment. The anal segment is small, carinate, more distinctly at base, visible only from beneath, being overlaid by a corneous plate bearing two spinose and granulate processes. Viewed from above the space between these processes is somewhat semicircular in outline, and the two *cul-de-sacs* between them are distinctly visible. From beneath the processes look almost straight and the *cul-de-sacs* do not appear. The accompanying figure will give a much better idea of this complicated structure than a description can convey.

Spiracles in nine pairs, the first situated in the mesothorax under the anterior angles, the rest abdominal. The pair on the first abdominal segment is dorso-lateral, the next lateral, and the remainder (in segments 3 to 8) are ventro-lateral; all except the last pair, which are behind the middle, are placed nearer the anterior than the posterior margin of the segment.

Legs stout, coxæ not very prominent, femora strong, broader at tip and compressed within, tibial pieces subcylindrical, claws single, long, curved, with an indistinct blunt tooth and a bristle near the base. The suture between the femur and trochanter is well marked, and these as well as the tibiæ are rather sparsely bristled.

Larvæ of the above mentioned species were taken at Iowa City on the 13th of April from beneath the bark of a rotting elm log. On the 7th of May one of them changed to an elongate white pupa, 16 mm. in length, which had the power of moving very rapidly about on its back, tail foremost. It was very sensitive, a slight touch on any of the bristles sufficing to set it in motion. The beetle appeared on May 16th.

In a short note on page 76 of the third volume of PSYCHE, Mr. H. L. Moody has given us a means of distinguishing the larvæ of four of the species of the family Pyrochroidæ that he has raised. The larva of *Schizotus cervicalis* he says is of a smoky tint, while the remaining three (mentioned hereafter) are yellow; of these, *Dendroides canadensis* has long, slender, curved processes nearly one-third longer than the basal portion, and the *cul-de-sacs* not visible from above; *D. concolor* has stouter, nearly straight processes hardly longer than the basal portion, and the tips are obliquely cut off on the inner side, while the *cul-de-sacs* are just visible (by the projecting lower margin) from above. In *Pyrochroa flabellata* the processes are nearly straight on the inner edge when viewed from below, and short, strongly dentate; the *cul-de-sacs* are very large, plainly visible from above. I notice that the length of the processes is subject to some little variation, but no doubt these characters will hold good in general.

EXPLANATION OF PLATE.

Fig. 1. *Hololepta fossularis* Say, larva; *a*, pupa; *b*, mouth and antenna from below; *c*, anterior leg; *d*, caudal appendix.

Fig. 2. *Pyrochroa flabellata* Fabr., larva; *a*, pupa; *b*, antenna; *c*, mandible; *d*, terminal portion of abdomen from below; *e*, maxilla; *f*, mentum.

H. F. WICKHAM, Iowa City, Iowa.

ARCHEOLOGY AND ETHNOLOGY.[1]

Gailenreuth Cave in 1894.—Dr. Zittel says (Beiträge zur Anthropologie und Urgeschichte Baierns ii, p. 226) that the remarkable discoveries in the English and French caves about 1875, caused the comparatively recent exploration, notably by Dr. Fraas (about 1877), of caverns in the limestone valleys of the upper tributaries of the Main (in the Franconian Switzerland, Bavaria) and along the northern confluents of the Danube (in Würtemberg). But, as he explains, J. F. Esper (Ausführliche Nachricht von neuentdeckten Zoolithen, 1774), had scientifically examined several of the Wiesent Valley caves (in Franconia) more than a hundred years before, and, as far as is known, had anticipated all investigators—even the Rev. McEnery, the long-neglected explorer of Kent's Hole—in the discovery of human remains associated with the bones of extinct Plistocene mammals.

The cave map of Bavaria (Beiträge zur Urgesch. Bai. 2, plate 14) is thickly dotted with the red signs for caverns in the mill region north of the right Danube bank between Ulm and Ratisbon, here and there in the Alpine valleys of the Iller, Isar and Saal far to the southward, but thickest of all along the upper Main Valley by the Wiesent, Ailsbach and Püttbach tributaries, about a spot twenty miles to the southwest of Bayreuth. Here it was, in the hill-top cave, one-quarter of a mile from the Castle Gailenreuth (left bank of Wiesent, two miles above Muggendorf), that Esper's most important work was done. The entombed bones of legendary Dragons and Unicorns, the extraordinary teeth exhumed during the Middle Ages to be ground into medical nostrums, had not yet been rearranged into the now well-known shapes of Mammoth, Cave Bear, Hyena and Rhinoceros. Human prehistoric work in stone was unrecognized, and the existence of River Drift and Cave Men was unsuspected, when at Gailenreuth, on finding a human jaw with three teeth and a shoulder-blade in a layer of "Antediluvian" bones, Esper made the memorable observation:

"Since they (the human remains) lay under the animal bones with which the Gailenreuth Cave was filled; since they were found in what, in all probability, was their original layer, I infer, not without adequate ground, that these human relics were of like age with the animal remains above them."

This remarkable inference, in 1774, making Gailenreuth classic ground for the cave explorer, was carried no farther by Esper. Nor

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

did it impress Buckland who, though he visited the cave in 1816, and carried a skull afterwards found (now in the Oxford Museum) to England, seems to have regarded with indifference the similar observations of McEnery at Kent's Hole. No further cave exploration was undertaken in the Franconian region until 1878.

The Gailenreuth Cave or "Zoolithenhöhle" enters the top of a gentle hill separated from the brink of the widest gorge (about 290 feet deep) by a level plateau. Cold and wet as I found it, in August, 1894, and accessible from the stream only after a steep climb, with an entrance (now walled up) invisible from the valley, and not at all conspicuous from the plateau above, the remote forest-hidden cavern, like Hartman's Cave in Pennsylvania, had the look rather of an animal den than a possible habitation for primitive savages.

Esper found its two spacious chambers as now level-floored with the entrance and ending in two or more chasms 20 feet deep by 6 to 10 feet in diameter in the rear. His description makes it uncertain whether he dug his trenches at the bottom of the chasms or on the chamber floors, how deep he went, and whether he reached rock bottom. In his search for bones the following points were noted:

(1) *The pottery.*—The whole cave floor (chambers and chasms) was covered with a bed of charcoal, above which rested a layer of potsherds. These he divided into four kinds: (a) rude hand made of red brick clay mixed with coarse sand; (b) of rude, sandy clay, with fragments of quartz; (c) of finely worked potters' clay, smoked dark and glazed outside and in; and (d) of carefully worked, fine red potters' clay.

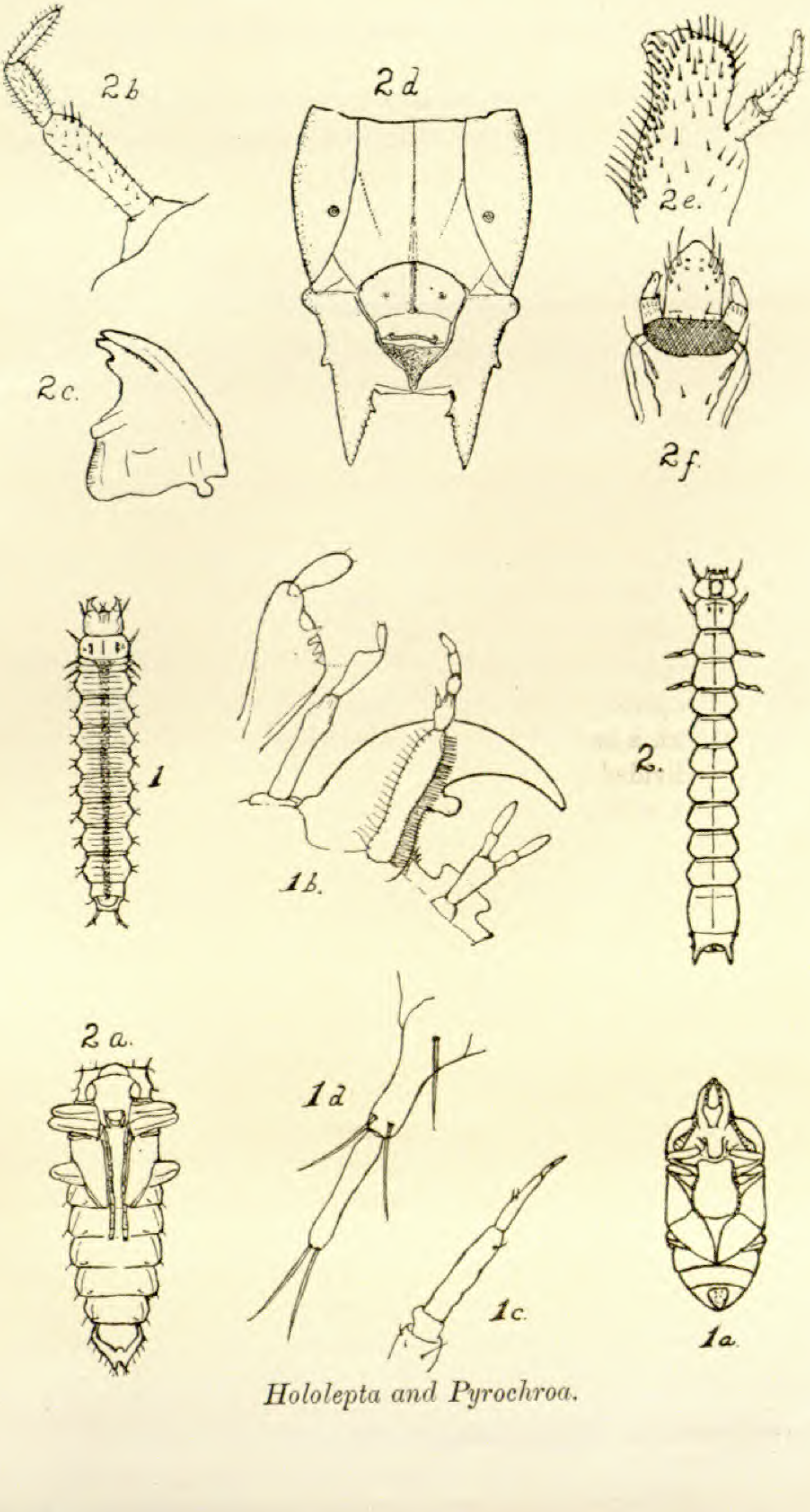
Repeating the notion of cremation of bodies, he supposed that the potsherds were the remains of the urns in which food had been placed near sacred fires built by Huns or Wends to the spirits of their kinsfolk 800 to 1000 years before.

This pottery is still abundant. I scratched out several pieces in the disturbed earth at the bottom of one of the chasms. Esper says that it does not occur at a greater depth than three feet.

(2) *The immense number of animal bones*—The fauna afterward identified, given by Ranke, consisted of Mammoth, Giant Elk, Reindeer, Cave Bear (dominant), Gray Bear, Brown Bear, Cave Lion, Cave Hyena, Woolly Rhinoceros,[2] Wolf, Fox, Beaver, Glutton, Cave Rat and Ground Squirrel. The bones lay in confusion at the bottom of the chasms and in a thick bed under the potsherds on the chamber

[2] Ranke (Beiträge 2, p. 196), quoting Dawkins, does not mention Woolly Rhinoceros, Glutton (*Gulo spelaea*), Beaver, *Arvicola spelaea*, and Squirrel, but I found them labelled from Gailenreuth in the Schloss Museum at Bayreuth.

PLATE XXVI.



Hololepta and Pyrochroa.

floors, and how they got there has remained a puzzle to the present day. I found the gnawed fore-leg bone of *Ursus spelaeus* at the bottom of one of the chasms, but the Carnivora or men could not have brought in the fossils, since none, it seems, have been mentioned as split for the marrow and very few gnawed.

If water washed them in (and this has seemed likely from the pebbles found mixed with them), then we must imagine a valley nearly the size of the Niagara Gorge, as yet uneroded, with the Wiesent somehow sweeping into the cave the bones and not the carcasses of animals that had perished along its shores.

Animals often go into caves to die, but Esper urges they could not have done so in this case, as he found no skeletons entire. He suggests an immense flood driving them to the cave for refuge, where, being drowned, their remains were washed about and broken by surging waters. But, after fairly stating the objections to this and other theories, he gives up the problem in despair.

Esper based his notion of the immense number of animals represented, not on the fragments found, but upon a white, chalky layer of decomposed bones, which he does not describe as continuous, discovered by him in several parts of the cavern. If we give this up as a test of quantity, we have only left for a witness of the often alleged prodigious number of individuals in Gailenreuth, the thickly scattered fragments from 3 to 6 inches long, and in the proportion of about 15 to a half bushel of earth, which I saw on scratching with a hoe, at the bottom of the chasms.

Spite of all the bone hunting done in the cave, there are probably as many of these pieces (which no collector would want) as ever. And if it is fair to guess at the ratio of bones to earth from them, and from the odds and ends set in the growing stalagmite of the walls, the number of entombed animals, though great, was not extravagantly so.

(3) *The human bones.*—The jaw and shoulder blade Esper found at a depth, not exactly stated, of several feet under an extending ledge of rock at a point not since identified. They were bedded in a layer one foot thick of fossils mixed with pebbles, which underlaid the white chalky stratum of decomposed bones above noted, and have been, unfortunately, lost. I found no description of the position of the skull mentioned by Ranke as afterwards found in the cave, and taken to England by Buckland.

Potsherds, according to Esper, were found at depths of three feet, and without more conclusive evidence, it must remain doubtful whether in this case the human bones were not intrusive and to be referred to a later time than that of the fossil animals.

In the bottom of one of the chasms, which had evidently been disturbed by previous digging to a considerable depth, my scratching brought to light two teeth, a lower jaw and leg bone of *Ursus spelaeus.* The wet stalagmitic walls of the rift were scantily bedded with bone fragments, and I saw many pieces set in loose fragments of breccia which recent fossil hunters had gouged out of the walls and found not worth taking away. No doubt crusts of stalagmite projecting here and there from the walls over the cave earth had been broken through, but I saw no signs of previously-existing floors of large extent in the chasm.

Here, where some loose bones steeped in carbonate of lime were hard as stone, while others projected from the drip looked comparatively fresh,[3] the value of breccia, of fossilization, and of stalagmitic crusts covering underplaced layers as tests of age seemed small. Still more was I inclined to reject such criteria when, a few days later, I was shown stalactites 60 centimeters long produced in fifteen years on the reservoir roof at Bayreuth, and when Professor Adami, of Bayreuth, told me that he had seen, in 1884, stalactites in a tunnel between Zelfenkasten and Conters (in Switzerland) 6 inches long and forty years old. It was soon apparent that a great deal of digging had been done in the cave. No doubt the searchers for "Unicorns horns" had been there before Esper. Doubtless "Neuhaus Hans" of recent local fame had found profit in the contents of down-reaching fissures. But, in spite of the frequent overturning of mould and breccia, it might not be impossible still to demonstrate the meaning of the layers at Gailenreuth. The bottoms of the chasms have probably, owing to the cramped space, never been reached, and several places may well exist in the upper chamber floors that have not been disturbed at all. However that may be, Gailenreuth, the starting point of modern cave exploration, shows well the bearings and the difficulties of real work done in caverns, and suggests many of the puzzles which still perplex the investigator.

H. C. MERCER.

[3] Like the Cave Bear and Lion skulls in the Schloss Museum at Bayreuth.

MICROSCOPY.[1]

Notes on Gold Impregnation Technique.—The following method of using formic acid and gold chloride is a modification, or adaptation of a method used by Miss Julia B. Platt and kindly suggested by her to me. She refers it to Professor Mark of Harvard University. I have used it in tracing the nervous system of *Nephelis lateralis* and have found it reliable. In leech tissues, it differentiates all nerve tissue, though the histology of other tissues is poor. After more than a year's use of this method without a complete failure among my preparations, I feel that Lee's characterization of the other methods of gold staining does not apply to this method.

It has been used successfully on larval vertebrate material as well as on leech tissue, by varying the strength of the formic acid, or the time of its application. The other factors are to a great extent indifferent as to strength used or time employed. If maceration occurs, lessen the action of the formic by weakening or by shortening the time. If the impregnation is slight, increase the action. The thickness of the piece stained should not exceed 5 mm., and the tissue must be living.

The following is the process employed with *Nephelis:*

The leech is put into twenty or thirty times its bulk of 10% formic acid and left from 3 to 5 minutes. It dies well extended. Transfer without washing to 1% Gold chloride (of commerce) for 25 minutes; then without washing into 1% formic acid for 24 hours, or until reduction is complete. This is indicated by a rich purple color over the whole specimen. Wash slightly in tap water; run up through the alcohols to chloroform; to chloroform saturated with hard paraffine. My sections are usually cut 16μ thick. When the impregnation appears to be very light—almost a failure, stain the sections on the slide with erythrosin or some other deep red anilin stain for contrast. These sections will often show the most exquisite details.

Transparent larvæ 5 to 10 mm. long require a milder treatment, such as the following: 5% formic acid 2 or 3 minutes, 1% or ½% gold chloride 10 minutes, weak formic 1 to 4 hours. If the specimens are watched from time to time under the dissecting lens, it will be seen that the central nervous system stains first and then the peripheral. The reduction of the gold chloride may be stopped, of course, at any point by transferring to alcohol.

[1]Edited by C. O. Whitman, University of Chicago.

All the operations described above were conducted in diffuse daylight and the gold chloride solution was exposed to sunlight for some time before using. This may not be an essential factor to the process, but Dr. L. Lindsay Johnson, in the third edition of Lee's *Vade Mecum*, suggests that failure to ripen the solution by sunning may be the cause of many of the failures in gold staining.

C. L. Bristol.

University of Chicago, April 14, 1894.

Gold Chloride–Formic Acid Staining of Sections after Fixation in Sublimate Alcohol.—S. Apathy in the the Zeitschrift für Wissenschaftliche Mikroskopie. Bd. X, 1893, p. 348.

The following method is extracted from an article on the muscle fibres of Ascaris.

Take equal parts of a saturated solution of corrosive sublimate in a ½ per cent solution of common salt and absolute alcohol; or dissolve 3 per cent of corrosive sublimate and ½ per cent common salt in 50 per cent alcohol. Use the liquid boiling hot for Ascaris, cold for leeches, and leave the animals in it for 24 hours, or at least 12 hours. Wash out in 50 percent alcohol until the mahogany-brown color of an iodine-alcohol solution remains unchanged for a few days. Free the tissues from iodine in 90 per cent alcohol. Imbed in paraffin, using chloroform for the transferring medium, and fix the sections on the slide. Free them completely from paraffine and chloroform, and finally wash slightly with distilled water.

Put the slide in a 1 per cent gold chloride solution and keep in the dark for 24 hours. Drain the slide and lightly apply a smooth-faced blotting paper to take up the surplus liquid. A $\frac{1}{10}$ per cent solution of gold chloride will answer, and is, of course, cheaper. Without further washing put the slide in a large bulk of 1 per cent formic acid and leave it for 24 hours. The longer diffuse daylight acts on the sections, the better the results. Wash in distilled water and mount in balsam. The sections may be cut very thin or thick—from 1μ to 15μ, but the author found the best results from sections 2 or $2\frac{1}{2}\mu$ in thickness.

"By this simple procedure, founded on a well known method, are produced the most beautiful pictures of the finer details of various tissues, but especially muscle and nerve fibres. The various elements of the tissue are stained in different tints from rose to cherry red or red-brown and are sharply defined."

A Rapid Method of Hardening and Sectioning.[2]—Every practical pathologist must be convinced of the great importance, in many cases, of at once supplementing and completing the naked eye examination of structures by a thorough microscopic examination. Microscopic examination in the fresh state, by teasing up parts of tissues, or by means of scrapings from the cut surface, is in most cases imperative if the finer details of the cellular elements are to be fully appreciated, but sections are no less necessary in many cases if the relations of the various constituents, and the structure with the tissue as a whole, are to be determined. In order to do this the method of freezing the fresh tissue, and cutting sections with the microtome is frequently adopted, but it must be the general experience that such sections are often very unsatisfactory. They are so loose and lacking in cohesion, and the process of freezing alters the tissue so much, that they are difficult to manipulate and often difficult to interpret. I have occasionally met with errors in diagnosis made by incompetent observers from the use of such sections. In order to obtain satisfactory results, the processes of hardening, embedding, section-cutting, staining, and mounting are all necessary, and these commonly extend over several days. If the process can be so shortened that the whole investigation can be completed at one sitting, then a considerable practical advantage will be obtained. How often does it happen in the course of a pathological investigation of parts either obtained post-mortem or from operation that we wish to be satisfied on the spot as to the real significance of some particular appearance. If the structure is put aside to harden, there is considerable likelihood of some of the points being forgotten, and, at any rate, it is not taken up with the freshness of the first examination. I believe also that for purposes of surgical diagnosis an examination made within an hour's time would often be found of great value.

The method I have now to describe has no claim except as a practical working procedure. I have mentioned it to several friends, and have met with a general expression of its usefulness. I have used it constantly for more than a year, and am perfectly satisfied that it fulfils its purpose. The principles of the method are : (1) rapid hardening in alcohol ; (2) cutting with the microtome without removing the alcohol and without freezing the tissue ; (3) rapid staining.

1. The hardening is effected by absolute alcohol, kept at a temperature about that of the animal body. In examining the fresh tissue

[2]Journ. Pathology and Bacteriology, II, No. 4, May, 1894.

with the naked eye the pathologist makes up his mind as to what exact parts he desires to submit to microscopic examination. With a sharp knife he takes a thin slice of such a part, not more than two to four millimetres in thickness and of comparatively small superficial area. The piece of tissue is placed in a test-tube containing some cotton-wool at the bottom, and half-filled with absolute alcohol. The slice is so placed in the tube that it shall lie flat and not be distorted or curved. The vessel is now to be placed at a slightly elevated temperature, for which purpose a water bath is most suitable. I use a hand basin, the hot tap of which is left running so as to keep the water at a temperature which may be judged of by the hand. The slight current in the water is a distinct advantage. If the piece be at all bulky it may be well to renew the alcohol after a short interval. In the course of half an hour or three quarters the slice of tissue will generally be found sufficiently hardened to be proceeded with further.

2. In the next stage advantage is taken of the fact that anise-oil freezes at a comparatively high temperature (45° to 70° Fahr.), and that the presence of alcohol does not interfere with the process of freezing. My attention was called to this agent by a paper by Kühne. This author recommends anise-oil as an embedding material, but I have not found the method which he recommends very successful. I use the anise-oil, not to penetrate the tissue, like celloidin or paraffin, but rather to hold it and fix it on the plate of the microtome. Having taken the slice of tissue from the alcohol, I dry it with blotting-paper or an absorbent cloth. I then pour a few drops of anise-oil on the plate of the freezing microtome, and place the piece of tissue in the midst of the oil. It is better to have the oil making one convex drop with the specimens in the middle of it, as in cutting the sections the less oil you take with you the better. A few systoles of the ether-spray bellows suffice to freeze the oil into a white solid mass. The knife is now used with a considerable sweep, and the section may be cut dry if its superficial area be small. If this cannot be done without risk of tearing, then the upper surface of the blade may be moistened with alcohol. The microtome which I use for the purpose is a Schantze, and any microtome with a sliding knife will serve. It is possible, by this method, to obtain sections sufficiently thin for most purposes, although not equal, of course, to those which may be got after embedding in celloidin or in paraffine.

In regard to the size of the piece of tissue to be cut, it is certainly better to have it of small dimensions, but the method is perfectly applicable to such a piece as would involve, say, the whole thickness of the kidney including cortex and pyramids.

After the sections are made they are placed in alcohol, which dissolves the anise-oil.

The sections so obtained may be stained with any of the ordinary agents. I used Biondi's fluid a good deal; it is rapid and differentiates well. Perhaps the most generally useful stain is Mayer's carmalum. This has all the advantages (and they are many) of alum-carmine, and has some additional ones of its own. Thus it is much brighter in tint, and so forms a better contrast. This is of special service when Gram's or Weigert's method is used for the detection of microbes, as the blue tint of alum-carmine is often objectionable when the microbes are stained blue. I commonly use picric acid as a contrast stain with the carmalum. The solution used consists of alcohol seventy parts, saturated watery solution of picric acid 30 parts, and hydrochloric acid ½ part. I find the results obtained to be much better than those yielded by picrocarmine in my hands. The whole process of staining by carmalum and picric acid need not take many minutes. If necessary a gentle heat may be used to hasten the action. An excellent method of staining, in many respects, is that described by Nicolle. It is introduced as a method of staining microbes which do not stain by Gram's method. The staining agent is Kühne's or Sœffler's blue. I have used, chiefly, Kühne's blue, which acts very rapidly, a few seconds being usually enough. It is so very vigorous, that dilution is sometimes necessary. The section is then washed in water and treated with a 10 per cent. solution of tannic acid. This has the effect of fixing the blue color in nuclei and microbes, so that subsequent treatment with alcohol and oil of cloves will not remove the color. The section is taken from the tannin solution, washed in water, dehydrated with alcohol, cleared with oil of cloves, washed in xylol, and mounted in Canada balsam in the usual way. If a contrast stain he desired, then eosin or acid fuchsine may be added to the tannin solution.

To summarise the method it may be put as follows:

1. Select an illustrative part of the fresh tissue, and remove a slice with a sharp knife.

2. Place in absolute alcohol and heat the vessel in a water bath to about 40° C. for half an hour to an hour.

3. Dry the tissue and place on the freezing plate of the microtome in a large drop of anise-oil.

4. Freeze and cut sections. The upper surface of the knife may be moistened with alcohol while cutting.

5. Place in alcohol to remove anise-oil.

6. Float out in water and place on slide for staining.

7. Stain by any approved rapid method, and mount.—JOSEPH COATS, M. D.

SCIENTIFIC NEWS.

Walker Prizes in Natural History.—Two prizes are annually offered by the Bŏston Society of Natural History for the best memoirs written in the English language on the subjects given below. For the best memoir presented a prize of sixty dollars may be awarded ; if, however, the memoir be one of marked merit, the amount may be increased to one hundred dollars, at the discretion of the committee. For the next memoir, a prize not exceeding fifty dollars may be awarded. Prizes will not be awarded unless the memoirs presented are of adequate merit. The competition for these prizes are not restricted, but open to all. Each memoir must be accompanied by a sealed envelope enclosing the author's name and superscribed with a motto corresponding to one borne by the manuscript, and must be in the hands of the Secretary on or before April 1st of the year for which the prize is offered.

Subjects for 1895 :—(1) A study of the "Fall line" in New Jersey; (2) A study of the Devonian formation of the Ohio basin ; (3) Relations of the order Plantaginaceae ; (4) Experimental investigations in morphology or embryology.

Subjects for 1896 :—(1) A study of the area of schistose or foliated rocks in the eastern United States ; (2) A study of the development of river valleys in some considerable area of folded or faulted Appalachian structure in Pennsylvania, Virginia or Tennessee ; (3) An experimental study of the effects of close-fertilization in the case of some plant of short cycle ; (4) Contributions to our knowledge of the general morphology or the general physiology of any animal, except man.

NOTE.—In all cases the memoirs are to be based on a considerable body of original work, as well as on a general review of the literature of the subject.

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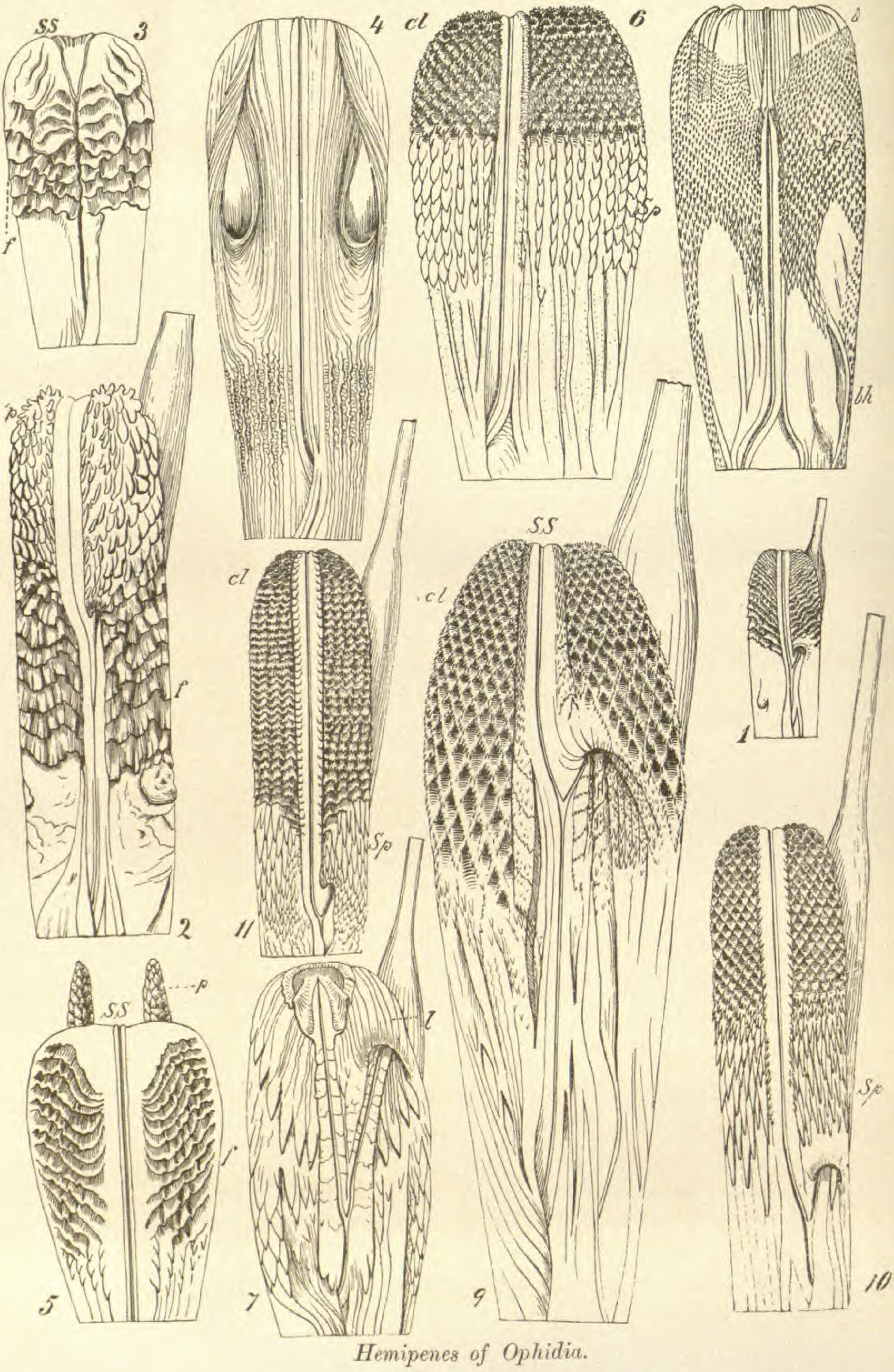

Hemipenes of Ophidia.

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THE CLASSIFICATION OF SNAKES.

By E. D. COPE.

Owing to the absence of limbs and other points in which diversity is usually apparent, the classification of the snakes has always presented difficulties to the zoologist. An order which dates from Cretaceous time and has spread over the entire world, must have differentiated in structure, if its history has been like that of other orders of Vertebrata. Yet the researches of anatomists have only resulted in finding characters which define five suborders, and about a dozen families. Of the natural groups thus defined, one family, the Colubridæ, embraces three-fourths of the species, and is of cosmopolitan distribution. So long as this was the principal result attained, it remained clear that the stronghold of the order had not yet been taken.

The primary divisions above referred to, are defined by peculiarities of the skeleton, and these were mostly originally described by Johannes Müller. In the preparation of their Herpetologie Génerale, Duméril and Bibron made a full study of the dentition. The results they obtained were important, but they were very far from expressing an exact and clear cut classification. The greatest defect of their definitions based on the teeth is that they too often fail to define. One type passes by easy gradations into another, so that in many cases it is impossible to determine what type a given dentition represents. In most cases it is clear that, among Colubrid snakes at least, no higher groups than genera can be predicated on dentition, and frequently not even these. Under such circumstances further structural characters had to be sought for if we are to have any clear idea of the affinities and phylogeny of this curious branch of the Reptilia. In any case no systematic arrangement can be regarded as final until the entire anatomy is known.

In 1864[1] I pointed out that certain snakes, notably the water snakes, have the vertebral hypapophyses continued to the tail, as in the truly venomous forms. Boulenger has since found this character in a good many forms which I had not examined, and which have no affinity to the water snakes. This character, while important, presents the same evanescent stages in certain types that the dental characters before noticed exhibit. It had long appeared to me that the only prehensile organs possessed by serpents, the hemipenes, might probably present structural variations expressive of affinity or diversity. In 1893[2] I examined these structures in many of the leading types, and was gratified by the discovery of a great many structural characters. In fact these organs exhibit a variety of ornamentation and armature beyond any part of the anatomy in the Ophidia, and I am satisfied that they furnish more important indication of near affinity than any other part of these reptiles yet examined. No one hereafter can be sure of the place of a serpent in the system until the hemipenis has been examined.

Still another part of the structure remained to be studied. The assymmetry of the lungs of snakes had often been noted by anatomists, but very little was known as to the range of variation. Accordingly the present year,[3] I undertook a study of the pulmonary organs. I was able to confirm observations previously made by Schlegel and Stannius, and to correct some others, and to add a great number of facts as to species not

[1] Proceedings Academy of Natural Sciences, Philada.

[2] American Naturlist, 1893, p. 477.

[3] Proceeds. Amer. Philos. Soc., 1894, p. 217.

previously examined. I cannot give here all the details observed, for which I refer to the papers quoted, but I give a general view of the results. One of these is that I am able to confirm the conclusion of Boulenger; i. e, that the Colubriform venomous snakes, the Proteroglypha, (cobras, Elapes, etc.), do not differ in any fundamental respect from the non-venomous Colubridæ, and that they can not be characterized as a suborder. The suborders then are:

Catodonta (Type Glauconia).

Epanodonta (Type Typhlops).

Tortricina (Ilysiidæ and Rhinophidæ).

Colubroidea (Peropoda, Asinea, and Proterogylpha).

Solenoglypha (Typical venomous forms).

The hemipenis is a projectile organ in the form of a hollow tube whose base is on one side of the middle line, and which opens into the anus. When retracted it lies beneath the tail, extending for a greater or less distance, and terminating in a cylindrical muscle. This has considerable length, and is finally inserted on a caudal vertebra. When the organ is projected this muscle is drawn forwards, so as to evaginate the tubular organ. Thus the inside of the tube becomes the outside, and the entire organ projects freely from its base anteriorly. It finds its way into the corresponding oviduct of the female (Plate XXVIII, v), and when once in place it cannot be tracted in most species, without invagination. This is performed by the contraction of the now internal retractor muscle. This is inserted on the internal face of the apex, and draws it inwards, so that it soon assumes the original ensheathed position beneath the tail. It cannot be withdrawn from the oviduct without invagination, because it is generally set with strong bony spines which diverge backwards. They have a perfect grip on the walls of the oviduct, and would in some instances lacerate that organ if the two bodies should be forcibly drawn apart. In other cases the hemipenis would be torn off at the base. Snakes sometimes partially project this organ, apparently in some instances for defence, as the spines are very pungent, and are sometimes curved like cats claws. Such at least would seem to have been the case with two *Heterodon platyrhinus*, (spotted adders), which were brought to me with the organs projected so as to present the spines. They were caught by a cat, and were represented to me as fighting their captor in this and other ways. Snakes are, however, very careful not to present these organs fully evaginated so as to expose the delicate structures near the apex. I have never seen this to be the case in an alcoholic specimen, (with one possible exception), and I should judge that this was the general experience, from the figures given by authors. It is said that male snakes may be compelled to project the hemipenes by holding them before a fire, but I have not seen this.

The hemipenis of the Ophidia is traversed by a groove which divides the superficial investment to the internal integument (or external integument when the organ is retracted), which commences at the base internally, and soon turns to the external side of the organ and continues to its extremity. This is the sulcus spermaticus (s s in Plate xxvii). This sulcus is always bifurcated in venomous snakes, and I find it to be equally bifurcated in many harmless snakes (Figs. 2, 3, 7). The investing tissues may or may not correspond with this bifurcation. Thus the hemipenis may be more or less bifurcate (Figs. 1, 2, 7, 9, 10, 11). Schlegel states that it is bifurcate in venomous snakes, but it is not so in the sea-snake *Hydrophis hardwickii*, nor in *Bungarus semifasciatus*, *Hoplocephalus coronatus*, etc., while it is bifurcate in many non-venomous forms. Next to the bifurcation of the sulcus in importance, is the nature of the surface of the external investment (internal when retracted). In the most perfect types both venomous and non-venomous, this surface is reticulate like tripe, the enclosed areas forming calyces, which may have a suctorial function (Figs. 6, 9, 10, 11). Their borders are often papillose, and are sometimes so deeply divided into papillæ as to lose their original character. These papillæ may be the seat of osseous deposit, becoming bristles or spines, (sp), which become larger toward the middle of the length, and lose their mutual membranous connections. These isolated spines may extend to the apex, but they rarely extend to the base. The surface may, however, be laminate and not reticulate, and the laminæ may be longitudinal (Figs. 4, 7) or transverse (Figs. 1, 2, 3, 5). In either of these cases they may not be spiniferous. The apex or apices of the organ may be furnished with a rigid papilla (Fig. 5) or awn.

In the Tortricina and Peropoda (the constrictors), the hemipenis is not spinous, and the sulcus is bifurcate (Figs. 1, 2, 3), and in the Boidae the hemipenis is bifurcate also, although in some genera (Xiphosoma, Ungualia), the branches are very short. The external integument is never reticulate, but is always laminate with elongate papillæ at the extremities, in Epicrates (Fig. 2), Xiphosoma, and Ungualia. The laminæ are pinnate from the sulcus as an axis, in Morelia, Enygrus, Lichanura and Eryx, and are transverse (flounced), in Charina (Fig. 3). In Ilysia they are pinnate (Fig. 1), with a few longitudinal plicæ below.

Similar gradations in the characters of the hemipenis are to be seen in the types of venomous snakes. Thus in the Proteroglypha this organ is spinous to the tip, on a calyculate basis, in Hydrophis, Elaps, (*surinamensis*); Dendraspis. It is reticulate at the extremities and spinous below, in Callophis (*bivirgatus*); Naja (Fig. 9); Acanthophis; Bungarus and Sepedon; the apex smooth in the two genera last named. In *Elaps nigrocinctus* the organ is smooth below, with spines at the apex.

In Solenoglypha the genus Atractaspis is spinous to the apex, apparently on a longitudinally laminate basis. In the Viperidæ and Crotalidæ the spines are on a flounced basis. The apices are calyculate in Bitis, Clotho (Fig. 10), and Vipera, and spinous in Cerastes. They are calyculate in Crotalidæ in Bothrops, Ancistrodon, Crotalophorus, Crotalus and Uropsophus (Fig. 11). In Crotalus (*durissus* of the Neotropical fauna), the papillae are not ossified; in all the other genera they are spinous.

The condition of knowledge as to the lungs of snakes was stated by Stannius, in 1856, as follows: "The detailed accounts as to the single or double character of the lungs leaves much to be desired. Among Ophidia Angiostomata there possess a single sack, Rhinophis and all Typhlopidæ which have been examined; as to the Tortricidæ [Ilysiidæ], there are apparently species with two lungs (*T. xenopeltis*) [=*Xenopeltis unicolor*], and others with a single lung (*T. scytale*) [=*Ilysia scytale*]. Among Eurystomata, all the Peropoda (Boa, Python, Eryx) possess apparently two lungs. The Calamarina that have been investigated have one lung. Among Colubrina and Glyphodonta, there are great variations. All the Coronellæ of Schlegel possess, according to Schlegel, a single lung. I find the lung single in *Rhachiodon scaber* [*Dasypeltis*]. *Tropidonotus natrix* [*Natrix vulgaris*] has a very small rudiment of a second lung. *Coluber* [*Spilotes*] *variabilis* possesses, according to Schlegel, the rudiment of a second lung. According to the statement of Meckel, this rudiment is common in Coluber. The Xenodons have, according to Schlegel, a single lung (*X. severus* and *X. rhabdocephalus*). In Heterodon I find a rudimental second lung. The Lycodons, according to Schlegel, possess a single lung; as also do Psammophis and Homalopsis. In *Dendrophis colubrina* Schlegel found the rudiment of the second lung. In Dipsas, according te Schlegel, there are variations; but he states that *D. multimaculata, D. lævis* and *D. annulata* [*Sibon annulatum*], have but one lung. The Achrochordina have but one lung. Among Hydrophidæ I found in three species of Hydrophis the lung-sack simple. Meckel states that Platurus has a very small rudiment of a second lung. Among the remaining poisonous snakes there is an insignificant rudiment of the second lung in the Elapina and Crotalina; while the Viperina possess an entirely simple lung."

An examination of about one hundred and fifty species of nearly all types yielded the following results.

The snakes with rudimental posterior limbs (Peropoda), show in the character of their lungs, what they show in the rudimental limbs themselves, and in the hemipenis, the nearest relationships to the Lacertilia. They possess, with an exception to be noted later, two well-developed lungs, one of which is larger than the other. The smaller lung lies to the right side and ventrally, while the larger one lies to the left side and dorsally. In some species the dorsal and ventral relation is more pronounced than in other. In the Colubroidea the right or ventral lung is generally present, but of very much reduced proportions, the usual size being from two to five millimeters in length (Plate XXVIII RL). It is connected with the other lung by a foramen which perforates the tracheal cartilage at a point a little beyond the apex of the heart, and opposite to the proximal part of the dorsal lung. It is sometimes connected to the dorsal lung by a short tube, in which cartilaginous half rings are seen in but two of the genera examined, viz., Heterodon and Conophis. The lumen of the rudimental lung may be lined by the same reticulate structure as is seen in the dorsal lung, or its walls may be smooth. In some Colubroidea the rudimental lung is absent, but such species are relatively few.

The dorsal lung may present proximally alongside of the trachea an auricle or pocket, and this is so developed in the genus Heterodon (Plate XXVIII), as to reach to the head, without communication with the trachea, other than that furnished by the normal portion of the lung. In the Solenoglypha, without exception, this extension of the dorsal lung is present, and extends to the head, and its lumen is continuous with the trachea throughout its length. The same structure exists in the genera Hydrus and Hydrophis; and also in the West Indian peropodous genus Ungualia, which differs besides from other Peropoda in having but one posttracheal lung. Finally the tracheal lung, as I shall call it, is distinct from the true lung in the water snakes Platurus and in Chersydrus. In the former of these genera the trachea is not separate from the lumen, while in Chersydrus it is distinct. It, however, communicates with the cells of which the lung consists in this genus by a series of regularly placed foramina on each side. There is no lumen in the tracheal lung of Chersydrus. In the blind burrowing Typhlops we have a still further modification of the tracheal lung. It is without lumen, and is composed of coarse cells of different sizes. These have no communication with the trachea or lung that I can discover. It has occurred to me that this structure, which extends from the heart to the throat, may not be a pulmonary organ.

I have referred to the dorsal and ventral positions of the two lungs. The rudimental lung is to the right of the dorsal lung in the Colubroidea, but in the Ilysiidæ it is to the left. It is quite questionable which lung this rudiment in this family really represents. In the Typhlopidæ, the single lung is on the right side and extends from the heart to the liver. It has the position of the rudiment lung of the Colubroidea, and may represent it. I cannot decide this question without further material. In Glauconia there is but one true lung, and this is ventral in position, and originates to the right of the heart, so that in this genus also it may represent the rudimental lung of the Colubroidea. There is here no tracheal lung or organ.

I have no doubt of the propriety of the separation of the Ungualiidæ from the other Peropoda, on account of its pulmonary characters. Nor is there any doubt in my mind of the necessity of the separation of the Leptognathinæ from the Xenodontinæ, on account of its large tracheal lung. The genus Heterodon differs very much from other Xenodontinæ, in the possession of an enormous diverticulum of the lung, but as it is not present in the allied genus Lystrophis Cope, its wider distinction may be a questionable proceeding. The very marked characters of the genus Chersydrus characterize the family, as well as the osteological characters. It remains to be seen whether the family I termed the Nothopidæ, but which Boulenger unites with the Chersydridæ, agrees with it in pulmonary characters. The remarkable tracheal lung or gland distinguishes the Epanodonta from the Catodonta, emphasizing the differences observed in the osteology of the skull.

The value of the rudimental right lung as a character of the Colubroidea is increased by my investigations. In only two genera have I found it present or absent, viz., Halsophis and Pityophis. I am not sure but that I may yet find it in the *P. melanoleucus*, where I have failed hitherto, but I am sure that it is present in some species of Halsophis and wanting in others. A natural group of American Colubrinæ, appears to be characterized by its absence, viz., Rhinochilus, Cemophora and Ophibolus; all genera with an entire anal shield. The development of cartilages in the bronchial foramen or tube of the rudimental lung is not a constant character. I found it in one *Heterodon platyrhinus* and not in another; it is present in *Conophis pulcher*, but absent in *C. sumichrastii.*

The rudimental lung is often concealed from view and difficult to discover. The best test of its presence is the foramen which connects it with the trachea, which will generally be found piercing the cartilage of the latter near the apex of the heart. The rudimental organ may then be found by inserting a bristle, and observing its destination through the more or less transparent tissues. In but one instance have I found a rudimental lung without a connecting foramen, viz., in the Mexican *Ficimia olivacea.* On the other hand, the foramen may terminate in a small blind sac.

The pulmonary characters may be determined without much dissection. The position of the heart must be first ascertained, and a longitudinal median incision made in the abdominal wall. In all forms except the Epanodonta and Catodonta, the trachea will be found passing to the left side of the heart, and entering the lung near its apex. By splitting the trachea, not too near its abdominal border, on turning the free margin upwards as the snake lies on its back, the *foramen bronchiale* will be seen and its lumen can be explored. The trachea is concealed by the œsophagus, which must be drawn to the left side of the body in order to make the examination. The examination of the tracheal lung requires the division of the abdominal wall farther towards the head.

The tracheal lung greatly extends the surface available for blood aëration. This is necessary to snakes for the reason that the huge masses of food which they ingest, so compress the true lung that another organ is necessary. Most snakes whether they have a tracheal lung or not, have the pulmonary organ greatly elongated, so that while one portion is compressed by the contents of the alimentary canal, another part is free to function. The tracheal lung enables the snake to inflate the anterior part of the body. This is conspicuous in the true venomous species (Solenoglypha). In the same way Heterodon inflates its huge diverticulum. In the marine water snakes Chersydrus and the Hydrophidae, these organs serve as floats.

In the fresh-water snakes (Natricinæ) there is no tracheal lung. The hemipenis of this group is very characteristic, (Plate XXXVII fig. 8).

As an illustration of the modifications in classification necessary in view of the characters which I have observed, I give an analysis of the genera of the group which I have called the Xenodontinæ.[4] These genera belong mainly to the southern Hemisphere, and chiefly to the Neotropical Realm, a few genera occcuring in Africa and North America. The characters of the division are as follows.

Hemipenis with bifurcate sulcus spermaticus, and armed with well developed spines, which are developed from the marginal papillæ of calyculi, when the latter are present. Hypapophyses of the vertebræ generally present only anteriorly.[5]

A. Lung without large proximal diverticulum.

I. Apex of hemipenis without calyces or spines but with a membranous disc. (Disciferi Fig. 7),

φ. Rostral plate not recurved.

Hemipenis undivided, no scale-pits;	*Aporophis* Cope.
Hemipenis divided; no scale-pits;	*Opheomorphus* Cope.
Hemipenis divided; one scale-pit;	*Xenodon* [6]Boie.

φφ. Rostral plate recurved.

Hemipenis divided; one scale-pit;	*Lystrophis* Cope.

II. Hemipenis transversely plicated (divided); (Flabellati).

Plicæ not pappillose; diacranterian;	*Helicops* Wagl.
Plicæ not pappillose; isodont;	*Pseudoeryx*[7] Fitz.
Plicæ pappillose; isodont;	*Rhabdosoma*[8] D. & B.

III. Calyculate, and not capitate (Calyculati).

φ. Hemipenis undivided.

Fusiform; isodont;	*Carphophiops* Gerv.
Colubriform; isodont; two nasals;	*Diadophis* B. & G.
Colubriform; diacranterian; one nasal;	*Amastridium* Cope.

[4] American Naturalist, 1893, p. 481.

[5] In Helicops they are continued to the tail.

[6] Including Liophis Wagl.

[7] Dimades Gray.

[8] Catostoma and Adelphicus are closely allied.

Colubriform; diacranterian; two nasals; *Hypsirhynchus* Gthr.

φφ. Hemipenis double.

Fusiform; isodont; *Farancia* Gray.

Colubriform; diacranterian; no scale pits; *Dromicus* Bibr.

Colubriform; diacranterian; one scale pit; *Monobothris*[9] Cope.

Colubriform; diacranterian; two scale pits; *Halsophis* Cope.

IV. Capitate (or pocketed) (Capitati).

φφ. Hemipenis undivided.

Scale pits single; scales smooth; *Pliocercus* Cope.

No scale pits; scales smooth; *Rhadinæa* Cope.

Scales keeled; prenasals in contact; *Tretanorhinus* D. & B.

φφ. Hemipenis divided.

Rostral normal; isodont; *Ninia* B. & G.

V. Pappillose at apex. (African) (Papillati).

Hemipenis single; *Grayia* Gthr.

Hemipenis bifurcate; *Theleus*[10] Cope.

VI. Calyculate with spinous bands to apex. (Calycispinosi).

Subisodont; attenuate; *Uromacer* D. & B.

VII. Exclusively spinous to apex; (diacranterian). (Spinosi).

Anterior teeth wanting; *Enulius* Cope.

Anterior teeth present; anal divided; no scale pits;
Echinanthera[11] Cope.

Anterior teeth present; anal entire; one scale pit;
Acanthophallus Cope.

A A Left lung with a proximal diverticulum, extending to the throat.

VIII. Calyculate and capitate.

Rostral recurved; hemipenis divided; diacranterian;
Heterodon Beauv.

Any one familiar with these genera will perceive that they are not represented in a linear series in the table. He will also observe that genera of probably not very close affinities

[9] Gen. nov. Type, *Dromicus chamissonis* Auct.

[10] Amer. Naturalist, 1893, p. 482.

[11] Gen. nov.; type *Aporophis cyanopleurus* Cope. This species is thought by Boulenger to be *Natrix melanostigma* Wagl; but that species is represented as unicolor above. The present species has three longitudinal bands, one median and one on each side.

are placed close together, as for instance Tretanorhinus and Helicops[12] and their associates. This is, however, a necessity of an artificial key and is not new in zoölogy. The characters presented by the hemipenis are more readily determinable, and are more constant that those to be found in any other part of the structure.

In further illustration of the same subject I present a synopsis of another tropical group, this time entirely American, which only differs from the Xenodontinæ in the grooving of the posterior maxillary tooth, i. e., the Scytalinæ.

I. Apex without calyces or spines, but with a membranous disc. (Disciferi).

Hemipenis divided; *Erythrolamprus* Boie.

II. Hemipenis transversely or obliquely plicate; (divided). (Flabellati).

No calyces; rostral plate normal; *Jaltris* Cope.
Calyces at apex; rostral plate produced; *Conophis* Peters.

III. Calyculate and not capitate. (Calyculati).

φ. Hemipenis divided.

Rostral recurved; *Rhinostoma* Wagl.
Rostral normal; pupil erect; *Oxyrrhopus* Wagl.
Rostral normal; pupil round; *Philodryas* Wagl.

φφ. Hemipenis undivided.

Rostral normal; *Thamnodynastes* Wagl.

IV. Capitate (also calyculate). (Capitati).

Hemipenis undivided; colubriform; *Coniophanes*[13] Hallow.
Hemipenis undivided; fusiform; *Hydrocalamus* Cope.

V. Spinous to apex; (divided). (Spinosi).

Two nasal plates; *Tachymenis* Wiegm.
One nasal plate; *Tomodon* D. & B.

VI. Apex smooth, or with one row of spines; (divided). (Levi).

Urosteges one rowed; a band of minute calyces; *Scytale* Wagl.
Urosteges two rowed; no calyces; *Lygophis*[14] Tsch.

[12] Helicops is certainly to be placed in this family and has no relationship to the Natricinæ with which it has been hitherto associated.

[13] The penial characters of Coniophanes distinguish it from Erythrolamprus, with which I have proposed to unite it.

[14] Type *Lygophis elegans* Tsch.=*Dryophylax poecilostomus* Cope.

Comparison of this table with that of the genera of Xenodontinæ, shows that both present identical modifications of structure in the case of five of the subdivisions. Only two types, (V and VI), of the Xenodontinæ have not been found in the Scytalinæ; and one, (no. VI), of the latter group has not been found in the Xenodontinæ.[15]

EXPLANATION OF PLATES.

Plate XXVII.

(From an unpublished Bulletin of the U. S. National Museum). Hemipenes of distinct types of Ophidia. The organ is split and the entire surface exposed. The student must remember that the lateral borders are artificial, and are continuous on the middle line behind the center of the figure in the projected organ. When the organ is bifurcate, but one branch is split; (figs. 1- 2–7–9–10–11).

Fig. 1. *Ilysia scytale* L. Brazil.
Fig. 2. *Epicrates angulifer* D. & B. Cuba.
Fig. 3. *Charina bottæ* Blv. Oregon.
Fig. 4. *Holarchus ancorus* Gird. Philippine Ids.
Fig. 5. *Oligodon subquadratus* D. & B. Java.
Fig. 6. *Bascanium constrictor* L. N. America.
Fig. 7. *Opheomorphus alticolus* Cope. Peru.
Fig. 8. *Natrix fasciata sipedon* L. N. America.
Fig. 9. *Naja haje* L. *melanoleuca* Hallow. W. Africa.
Fig. 10. *Clotho arietans* L. S. Africa.
Fig. 11. *Uropsopus confluentus* Say. Texas.

Lettering.

ss. Sulcus spermaticus; *f*, flounces; *p*, papillæ; *cl*, calyces or calyculi (ruches); *l*, laminæ; *sp*, spines; *spl*, spinules.

Plate XXVIII.

(From the Proceedings of the American Philosophical Society, 1894). Viscera of *Heterodon platyrhinus* Beauv. The

[15] **Reflection has caused me to drop the major division Xenodontidæ, and to refer its two subfamilies to the Colubridæ.**

heart is turned partly over, and the œsophagus is separated by being drawn to the left of the other viscera. One oviduct is split at the base so as to disclose the vaginal portion. In consequence the rectum is displaced to the right. The lettering is as follows.

Tr, trachea; *Car*, Carotid artery; *Hy* sheath containing hyoid cornua; *Oe*, oesphagus; *Vr*, vertebral artery; *A. P*, arteria pulmonalis; *L. L*, left lung; *R L*, right, (rudimental) lung; *H*, heart; *A R*, left aorta root; *V C*, vena cava ascendens; *L*, liver; *St*, stomach; *G B*, gall bladder; *Sp*, spleen; *F*, fontanelle of oviduct; *I*, intestine; *Ov*, ovary; *C A*, corpus adiposum; *K*, kidney; *Od*, oviduct; *R*, rectum; *U*, ureter; *V*, vaginal portion of oviduct; *Cl*, cloaca.

LIMITS OF BIOLOGICAL EXPERIMENTS.[1]

By Dr. Manly Miles.

The proposition to test theories in evolution by direct experiments on living organisms which has been favorably noticed, and the numerous futile feeding experiments that have been made at the Government experiment stations, raise the question as to the probable limits of direct experimental methods in dealing with biological problems. The "whirligig of time," in connection with a certain uniformity in the outcome of the modified processes of nutrition and reproduction in a number of individuals, must be regarded as essential elements in bringing about the gradual aggregation and perpetuation of the minute changes in living organisms which we recognize as processes of evolution.

Aside from these significant factors, which cannot be neglected, the exceedingly complex conditions involved in all biological activities appear to be formidable difficulties to overcome in attempting a direct experimental verification of theories relating to the various agencies concerned in evolution, or, in determining the relative value of foods in the processes of nutrition.

Intelligent breeders of domestic animals have no doubts in regard to the heredity of acquired characters, which, in the light of their experience, they look upon as a fundamental principle in stock breeding and one of the most important factors in the available means of improvement. The direct proof of this principle by experimental methods must, however, be difficult, if not impossible, notwithstanding the cumulative and apparently conclusive evidence presented in the history of the improved breeds, and the experience of successful breeders who have recognized its importance in the improvement of their animals.

The dominant influence of other known biological factors may completely obscure well marked special characters that

[1](Abstract of a paper read at the Brooklyn meeting A. A. A. S., Aug., 1894).

have undoubtedly been inherited, as in the familiar facts of atavism, and they must effectually prevent the detection of the initial stages in the development of any new characters under investigation, which may in fact have been potentially transmitted for a number of generations.

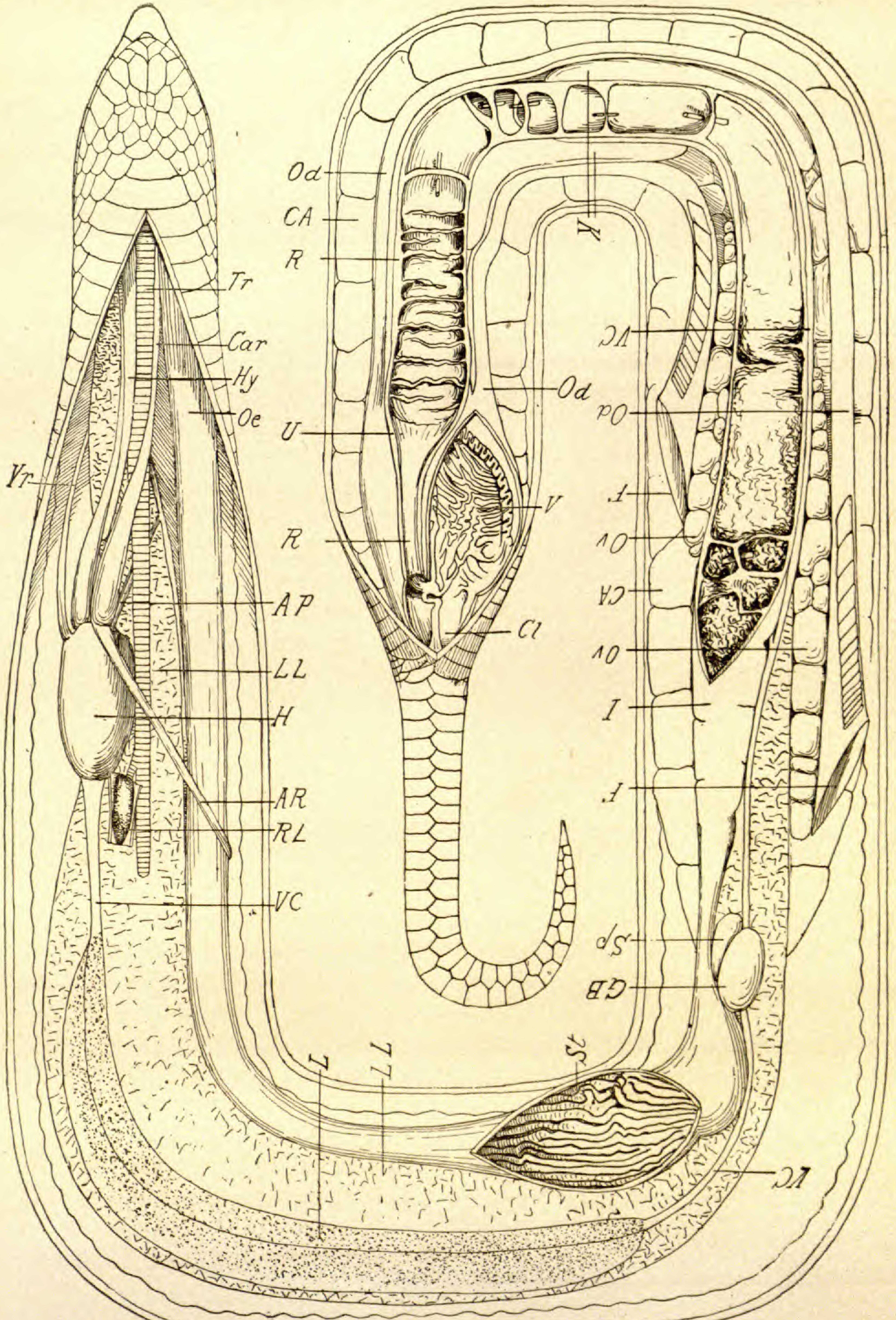
Reversion, prepotency, and the influence of a previous impregnation, are conspicuous obstacles in the way of tracing the immediate, or incipient indications of the inheritance of any particular acquired character which it may be desirable to perpetuate by judicious selections.

In many of the arguments relating to the heredity of acquired characters it appears to be tacitly assumed that each particular character is transmitted as an entity, regardless of its interdependent relations to other parts of the organism, and especially with the specific functional adaptations of the organs of nutrition which have made its development possible.

As pointed out in a paper read in Section F, at the Rochester meeting of the Am. Ass. Adv. Sci., physiological changes in the organism must precede any manifest modification of structural characters, and the transmission of a morphological peculiarity must, therefore, involve the transmission of the functional activities through which it has its origin. It was also shown that a habit or bias of the nutritive processes in a certain direction, may be transmitted for a number of generations without any visible morphological evidence of its existence, and that, in the lapse of time, it may lead to the development of obvious structural changes that are recognized as new characters. Experimental methods in biology are too crude to admit of a recognition of these preliminary steps in the development of new characters, which must be taken into account in making a satisfactory verification of any of the processes of evolution.

The artificial conditions to which our domesticated plants and animals are subjected, intensifies their susceptibility to variation, and there appears to be a constant tendency to reversion when any unfavorable conditions prevail in their treatment. Under ordinary management, repeated systematic

PLATE XXVIII.



Heterodon platyrhinus Latr.

selections are necessary in order to maintain the highest development of the most desirable characters, and a considerable number of individuals will be required to make any marked improvement in special qualities, as all do not respond alike to the artificial modifying conditions of their environment.

There are also individuals that retain a tendency to the prepotent transmission of the old race characters, notwithstanding the high development of the particular improved characters they possess, and a pedigree, showing that all known ancestors have had the desired qualities, is looked upon as a valuable index of the dominant inherited characters.

Even the best established breeds fail to exhibit the uniformity in their general characteristics which prevails in wild species that have been subjected to the more rigorous and discriminating processes of natural selection. The methods of artificial selection in the breeding of animals, are lacking in the inexorable consistency and comprehensiveness that characterize natural selection. The breeder of improved animals is unable to perceive all of their innate and acquired physiological tendencies, and his selections are made with reference only to the most obvious peculiarities, or qualities, and he overlooks and neglects many of the factors concerned in determining the correlated relations of the sum of their characters.

Feeding experiments to ascertain the relative nutritive value of different articles of food and the advantages of different methods of feeding, or, to determine the relative merits of different breeds, are especially liable to mislead, from the complexity of the problems presented—the small number of facts under observation—and the practical difficulties in the way of tracing the obscure relations of the most significant factors in the phenomena under investigation, to say nothing of the fallacious and obsolete chemical theories of nutrition that are too often adopted in a popular discussion of the results.

It is not my purpose to enter upon an exhaustive discussion of the limits of experimental biology, but to point out some of the practical difficulties involved in its methods and results. Without further reference to particulars, it must be evident that biological activities have such complex interdependent relations, that theories relating to evolution cannot all be verified, or practical problems in nutrition satisfactorily solved, by direct experimental methods.

ABALONE OR HALIOTIS SHELLS OF THE CALIFORNIAN COAST.

MRS. M. BURTON WILLIAMSON.

Although the coast of California produces, as a rule, dull or sombre tinted shells, yet in one family of molluscs the Californian province stands preëminent. This family is composed of shells familiary known on the West Coast as Abalone or pearly-ear shells. Among scientists the shells are called *Haliotis* and the family Haliotidæ. In the size of all its species of Haliotidæ California rivals the world. Japan has one fine species *Haliotis gigantea* Chemnitz, that compares very favorably with the large shells of California, and this species is also represented on the West Coast of the U. S. by a variety. Another fine shell that compares favorably with the Californian shells is *Haliotis midæ*, the first shell of this family named by the great Linneus or Linnè, who described it in 1758. Australia also produces a large species, but for the most part shells collected on other coasts are small, ranging from four to one inch in length.

In the geographical distribution of this family, the "center of distribution is in the Australian and adjacent seas."[1] Besides those collected on the coast of California and Lower California, these shells are found as far north as Alaska, also on the coasts of Kamtchatka, Japan, China, Philippine Islands, New Hebrides, New Caledonia, New Zealand, Aukland, Id., Australia, Malay Archipelago, Ceylon, Red Sea, West Coast of Africa and at the Cape of Good Hope, Canary Islands, Mediterranean and Adriatic Seas, French and English Coasts of the Atlantic, and also at the Cape region of South America. It has often been remarked that "not a single species" has been "found upon either coast of South America, or upon the East Coast of North America," but, in 1869, Pourtales dredged a small Haliotis in 200 fathoms near the Florida reefs. The

[1]Pilsbry.

shell was named by Dr. Wm. H. Dall *Haliotis pourtalesii*, but in the great fire of 1871 in Chicago, this little specimen together with the " entire collection of Pourtales and Stimpson," was burned. In 1887–88 the U. S. Fish Commission Steamer Albatross dredged a number of shells on the West Coast, and, at the Galapagos Islands, in the Pacific, on the West Coast of South America, two specimens of *Haliotes* were dredged. And, what is remarkable, the shell found in Florida from the bed of the Gulf Stream and the one from the Galapagos group were pronounced by Dr. Dall the same species with scarcely a doubt. The latter did not contain the animal and was not quite one inch in length.[2]

In the Manual of Conchology, Mr. H. A. Pilsbry says of the family Haliotidæ in geologic ages: "Of the genealogy of the family little is known. A few fossil forms not differing materially from the recent ones, have been discovered in the Pliocene and Miocene and one in the upper Cretaceous of Germany. Others will probably be found when the Australian Tertiary and secondary strata are more fully explored." Two species of Abalones are found in the Quarternary or Plistocene formation in Southern California.

There are about 85 species and well defined varieties of shells in this family. On the Californian coast six distinct species are collected and also two or three varieties. Some of these species are found as far south as Cape St. Lucas, Lower California, and one species extends to Alaska; this is supposed to be a variety of the Japanese species, reaching the Californian coast by way of Alaska. The species is *Haliotis gigantea* Chemnitz var. *H. kamtchatkana* Jonas. Besides this northern species, *H. rufescens* Swainson, *H. fulgens* Philippi; *H. corrugata* Gray, *H. cracherodii* Leech and *H. assimilis* Dall are collected. The last named is a deep water species.

The generic name *Haliotis* was also given by Linné in 1758. It is from the Greek *hals*, sea and *ous* ear, but wherever these shells are found they have local names. In California they are popularly known as " Abalone," of " uncertain ety-

[2]See Preliminary Report on Albatross Mollusca by William Healey Dall, Curator Dept. Molluscs. (Proc. Nat. Mus., Vol. XII, 1889).

mology." Some writers think the name is of Spanish origin[3] but a well known Spanish scholar, one of the Jesuit Fathers, told me he thought the name was a "provincialism." It is said these shells are called "Awabi" in Japan. The local names given to the shell in different countries refer usually to the shape of the shell, and, being translated, mean ear-shell, ear-of-the-sea, Venus' ear, etc.; also on account of its nacreous lining, Mother-of-pearl-shell, and because of the holes in the shell, "six eyes." The beautiful nacre or mother-of-pearl in the interior of these shells, and the rich colors visible when the epidermis or outside layer has been removed, has given rise to color names. The most beautiful shell, in the interior, is the green abalone (*Haliotis fulgens*). The green and blue nacre is as effectively blended as the colors in a peacock, and is indiscribably rich in tone. The centre is especially rich in iridescent effect. This center is scientifically known as the "muscular impression" for it is at this place that the animal is firmly adherent to its shell, though young shells are not marked by this "area of the muscular impression." In some specimens it is horse-shoe-shaped. In an article on the Abalone Fishery in "The Fisheries and Fishing Industries of the U. S." (U. S. Commission of Fish and Fisheries 1887), Earnest Ingersoll says in referring to this muscle scar: "In aged specimens the part to which the muscle is attached is raised above the level of the rest of the interior and presents a roughened or carved surface of irregular shape, often fancifully imitative of some other object. The writer has seen one which thus contained a singularly correct profile of Napoleon I." Instead of the muscular impression being "raised above the level," my observation has led me to conclude that with age the muscle scar is, as a whole, depressed.

The red abalone (*H. rufescens*) does not receive its name from the color of its mother-of-pearl, as does the green shell, but from the red margin that outlines the aperture and the beautiful red displayed on the outside when the shell is decorticated by the use of acids or the grindstone. Another species (*H. cracherodii*, named for a Mr. Cracherod) when submitted

[3]From *aulon* or *aulone*.

to the same treatment shows a black exterior and this is the "black abalone." It is also called the "white abalone" in reference to its pearly interior and exterior, if the calcareous layers have been ground off leaving only the mother-of-pearl on the outside, as is often the case. A species with corrugations (*H. corrugata*) presents a reddish-purple color when ground off by a skillful workman. All these shells take a beautiful polish, but, while the shells are made more attractive to the popular taste, scientifically their value is depreciated after they fall "victims," as Carpenter expresses it, "to the grindstone and acids." Physicists tells us that the play of tints visible in the nacre or mother-of-pearl is caused by the action upon light of the tiny layers composing the nacre. "These layers are microscopically corrugated and their edges meet the rays of light and partly decompose them as do the rain drops in a rainbow producing a play of colors." (I once dissolved the inner layers of an abalone shell in muriatic acid, the dish was placed aside for several hours and on seeing it again I was surprised to find a beautiful sediment of iridescent mother-of-pearl; pressure was applied, and the play of colors was gone. The result was new to me at that time and was a pleasant surprise).

Typical shells of the Gastropoda (so named because the "under side of the body forms a muscular foot for gliding along"), the class to which abalones belong, are spiral in their form. Although these shells appear flat, a close inspection shows a well developed spire, but in most species, the spire is small and the basal or body-whorl is unusually developed and depressed, and this gives the shell an appearance as though it were only one valve of a bivalve, for which it has often been mistaken when seen by persons unacquainted with these forms. The shells have a row of open holes usually from five to nine, on one side, but these vary in number as the animal grows older; the holes close, until old shells have been seen with only one or two holes left open.[4] These holes are on the left side of the shell and through them the tentacles of the animal are often protruded. When the animal is resting upon

[4]A California Conchologist has a shell with *all* the holes closed.

a rock, a slight blow upon the shell often causes the shell-fish to adhere more firmly to the rock and at the same time discharge jets of water out of every hole. When entirely at rest the abalone adheres to the rock and is as completely covered by his shell as a watch would be under an inverted saucer, excepting that the five or more holes in the shell admit the entrance and exit of water. The large muscular foot with its epipodial ridge bordered with cirri extends outside of the shell when the animal is gliding along. This foot is to all appearances only a muscular expansion of the body. The animal has no operculum or trap-door, as in most families of this class, as it is like the limpet in having no use for an operculum. Abalones have a short head and eye peduncles. The gills or branchia, intestines, etc., are all on the same side of the shell as the holes, and the "columellar margin is produced into a flattened spiral plate," that forms a ridge sufficiently broad to protect all the digestive organs. The heart has two lateral auricles. The mantle is cleft at the row of holes extending thus "as far back as the last open hole." The odontophore[5] or radula is large, and the variety and size of the teeth on this lingual ribbon can be seen without the aid of a microscope. A section of the odontophore makes one of the most attractive mounts furnished by the radula of molluscs.

Reference was made to the fact that sometimes old shells had only one or two holes open when the animal was very old; when such is the case the shell is usually covered with a growth of vegetation, worms, or other molluscs. Whole colonies of *Serpulorbis* attach themselves to one shell making a very heavy load for a shell-fish to carry, even one so muscular as the abalone. Although they do travel somewhat, it is not improbable that with age the animal becomes more and more sedentary until almost incapable of locomotion. An abalone brought from the Pacific, about 24 miles away, after it had shown very little appearance of life, crawled from a pail of sea water, eighteen inches in one night, where it was found dead in the morning. The abalone marks his passage by a

[5]The ondontophore, sometimes called the "tongue" or "lingual ribbon" is set with rows of sharp siliceous teeth. In a large abalone it is about 3 inches in length.

trail of mucus in the same way that a land snail (*Helix*) leaves a trace of secretion in his wake. Besides the extraneous growth on these shells, they are the home of numerous pholads which burrow into the shell the same as into soft rock. The little domiciliary squatters often cause protuberances in the interior of the shell where the borer has drilled through the epidermis and calcareous portions into the nacre, which is always supplied sufficiently to resent the encroachments of domiciliaries. Dr. Robert E. C. Stearns of the National Museum has written an interesting paper on animals that encroach on the domain of others,[6] and it is illustrated with a plate showing these protuberances in an abalone shell. A red abalone that showed, on the inside, the raised nodule or protuberance indicative of the presence of a small rock-borer, on the outside of the abalone showed no perforation as usual, but, instead, there was a round depression of nacre, the pholad (*? Penitella parva* Tryon) *had been completely covered with nacre,* but a hammer and a chisel discovered the little bivalve that had been sealed up in his own domicile. As I broke the little pholad in getting it out of the abalone shell it could not be identified otherwise than doubtfully.

As pearls consist of coatings of nacreous secretion they are sometimes found in abalone shells. These will not compare with pearls found in the pearl oyster, as the latter are unrivalled. Pearls in abalones are often pear-shaped and green in color, in fact some of these so-called "pearls" are peculiar rather than beautiful. One fine pearl *baroque* (irregular) was taken from under the columella margin of a green abalone. It is the property of Mrs. Prof. Lowe of Pasadena, S. California, and is about 2¾ inches long; it is three-cornered in shape, and at the widest and thickest part it is 2¼ inches around.

As is well known the habitat of abalone is among rocks, where, at *very low* tide, they may be found huddled together in a corner of a rock in a rock pool, or hedged in between fissures of immense rocks, always as though hiding from the

[6]On certain Parasites, Commensals and Domiciliaries in the Pearl Oyster, etc. (Smithsonian Report, 1886, pages 339–344, with three plates).

light. Their dingy exterior almost of the same color as the rocks on which they rest, make them scarcely noticeable save for the protuberances that are visible on the rocks from which they are very difficult to remove, a trowel or wedge, etc., being necessary to dislodge them. Fishermen and Chinamen are the principle collectors of abalones. To illustrate the strength of muscle developed in this shell an anecdote is sometimes told of a man who was collecting some shells, when one of the shell-fish drew his shell so closely to the rock the man's hand was securely pinned to the rock and he was drowned. At one time the man is a Mexican, at another a Chinamen; the occurrence at one period is at Santa Barbara, at another San Pedro, but, the story always begins with "I have heard, etc." Any one who has collected these muscular fellows would be wary about allowing even a finger to be in close proximity to the shell, nor is it necessary to do so, the trowel or tool used to dislodge the shell is all that is needed. That men have lost their lives while collecting these shells there is no doubt at all, as the tide sometimes comes with fearful force on the slippery rocks. Three or four years ago the local papers reported the drowning of a young fisherman while getting abalones at San Pedro. Last spring a San Francisco paper told how a coyote was entrapped in a Haliotis which the coyote found partly raised from a rock, and, on inserting his muzzle underneath to secure a breakfast, the abalone had "closed down on him and kept him a prisoner."

As an article of food it is the general impression that the Chinese are the only consumers, but this is a mistake, although as an article of commerce only the Chinese seem to value it highly. At a lonely "point" in one of the Palos Verdes Hills we once found a large number of abalone shells around a deserted camp-fire, the fish had evidently been cooked on the fire, then eaten from the shell by the fishermen. A slice of abalone, before it is cooked, laid upon a platter might easily be mistaken for a slice of fish. They are pounded before cooking. As a soup this shell-fish is said to be very palatable and it has frequently been mistaken, by the uninitiated, for clam soup. As an export the fish is dried after being removed from the shell. I have seen three and four dozen abalones dried and strung on a cord, in Mexican grocery stores, hung beside dozens of strings of red peppers or chilles so gratifying to the Mexican palate. Abalones, when dried, have the appearance of leather, excepting that they are oily in their appearance. In shape they are nearly oblong and two or three inches thick. The great muscular foot slopes backward over an inch before it is enlarged by the epopodial ridge with its numerous cirri, and this contraction is noticeable in the dried fish.

As an article of commerce the shells are of considerable importance, or rather have been, as it is said, the immense traffic has almost "stripped the coast as far south as Cerros Island," Lower California. Three hundred tons are said to have been shipped from the coast in one year. Fifty tons being handled by one man in a month's time. "The greater portion of these are (in 1889) collected on the coast of Lower California. The Chinese are the principal gatherers, notwithstanding they are probibited by the Mexican laws. The shells are sold at $20 to $35 per ton, according to the quality."[7] When shells are sold by the bulk there is always a large percentage of dead and imperfect specimens, as the best shells are picked out and sold to retail dealers on the coast. A shell that is perforated by worms or molluscs is of no value as a polished shell. When the animal has been removed from the shell and the latter has laid on the beach subjected to the sun and the weather, the mother-of-pearl becomes dull and unattractive, and such shells are known as dead shells.

In California dead shells collected on the beach are often used, instead of stones, for rockeries, and also as borders for flower beds. It would be impossible to enumerate the ornamental uses to which abalones are applied. "In China they are broken up and used for inlaying in connection with lacquer work for which the Chinese are famous. The Mosaics of Europe are often adorned in the same way." Although the pearl oyster (*Maleagrina margaritifera*) is used where a pearly-white tint, such as seen in the pearl handles of silver table

[7]The West Amer. Scientist, April, 1889, p. 12.

knives, etc. is desired, yet in mosaics and work enriched by a display of iridescent tints the nacre of abalone shells stands preëminent. Inlaid work is so universally used that an enumeration of articles ornamented in this way is unnecessary, but mention may be made of one use of these shells in lacquer that to an American or European may seem unique; its use in a " pillow end." When we think of a pillow we imagine a billowy roll all done up in white, but, a Japanese or Korean has a very different idea. In the Korean collection in the U. S. National Museum are some small pillows and the following description is given of the ends of two of them:[8] " Pillow end (Be-ga-mo). Circular piece of wood, lacquered, incrusted with Haliotis shell. Figures represent a tiger under a pine tree; along the border is a band of arabesque." " Pillow end (Ja-ga-be-ga-mo). Disk of wood fastened in the end of a cylindrical pillow case, in black lacquer with Haliotis shell. Subject, the great dragon rising from the sea into the sky in the spring season." In describing these pillow ends Mr. Walter Hough says: "The Korean pillow is a cylindrical case stuffed with hair or rice straw. It has ornamented ends. The first one mentioned is 8¼ inches in diameter, but is 'not part of a regular pillow,' being used as a 'arm-rest.' The second one is 8 inches in diameter."

As a medium for trade among the Aborigines of North America, abalones have been highly esteemed both for their beauty and importance when used as shell money. The shells in the latter case being cut " into oblong strips from one to two inches in length, according to the curvature of the shell, and about as third as broad as long." These were strung on a string and were used both as money and ornaments. Dr. Robert E. C. Stearns, Adjunct Curator of Molluscs in the National Museum, has written a comprehensive monograph upon the use of shells by the Indians, entitled " Ethno-Conchology, a study of Primitive Money," and in it is figured money made from abalones, which the Indians termed " Uhl-lo." In the recent excavations at the old historic town of

[8]Report of the U. S. National Museum, 1891, page 465.

Pachacamac, near Lima, Peru,[9] squares of mother-of-pearl were found in the graves of the Incas. These squares are only half the length of those figured in Dr. Stearns' paper. The pieces look like the nacre of abalones and each square has two holes drilled in it. As the graves, or burial place of Pachacamac is supposed to be over four hundred years old, these shell pieces are very interesting, revealing also the fact that the Incas considered shell ornaments valuable enough to be buried with their bodies. As these strips of solid silver, done up in a loosely woven cloth, were found in a mummy's hand, the pieces of shell were evidently not used as money, the silver having been cut for that purpose.

Dr. Stearns instances the purchasing power of an abalone from the fact that in New Mexico a horse had been traded for a shell. I was relating this incident to a friend who had spent some years with the Pueblos in New Mexico, and my friend said that that was not surprising, as, when she first went to New Mexico, some years ago, her brother bought her a good Mexican horse for $6.00, and the Indians were always as glad to receive attractive shells as money. This would not be a very extravagant price for an Indian to pay for a fine Haliotis, as a shell dealer once listed to me *H. fulgens* as high as $10.00. Whether any conchologist paid such price is unknown to me, but, a red abolone, when decorticated, has sold in Los Angeles for $5.00, but it was a large specimen and beautifully polished.[10] Like other commodities abalone shells are variable in price according to the demand, as well as quality.

[9]In the private collection of C. F. Lummus, Los Angeles, Cal.

[10]It is related that as high a price as $25.00 has been asked for an abalone having a peculiar muscular impression outlined in the interior of the shell.

THE DURATION OF NIAGARA FALLS.

BY DR. J. W. SPENCER.[1]

For the past century Niagara Falls has been considered a time measurer, but its greatest interest has risen since the growth of our knowledge of the Ice Age on acconnt of the expectation that in some way it can be made to tell something of the date of that period and indirectly of the advent of man, or his restrictions on account of the glacial conditions. The paper of which this is an abstract was primarily a physical study, setting forth the changing episodes in the history of the falls, and computing the age of the river, but leaving to others the application of the results in the question of early man.

The method of determining the age of the falls is the application of the mechanics of the river to the various conditions during the changing episodes of its history, in a large measure discovered by the author during the last fifteen years. The investigation differs from those of other writers who have simply divided the length of the chasm, excavated by the retreating falls, by the imagined or measured rate of the recession of the cataract. At a glance, even the most superficial reader can understand that if the height of the cataract be first reduced to one-half, and then again doubled, or if the volume of the river be reduced to one-fourth, such variations are bound to produce as great changes in the rate of recession as are indicated by the mechanical laws; and that if the conditions have not always remained constant, then the present rate of retreat has not always obtained—sometimes slower and sometimes faster. It is this question that the paper considers for the first time. In the much written, but, until recently almost unknown, history of Niagara River, we find that an approximately correct estimate of the age of the falls was made half a century ago by Lyell, upon a conjecture of the rate of re-

[1] Abstract of a paper read before the Am. As. Ad. Science at Brooklyn, August, 1894.

cession now known to be wholly erroneous. Again, within the last eight years, there have been several writers who have been using corrected cöefficients of retreat, still their results are more inaccurate than the guesses, as to the age of the falls, made a hundred years ago, yet they may be said to have approximated the truth within their observations, but the observations have become enlarged.

A hundred years ago, Andrew Ellicott estimated the age of the falls at 55,000 years. Forty years later, Bakewell made the falls about 12,000 years old. Over fifty years ago, Lyell conjectured the age at 35,000 years, and this estimate was commonly accepted until about a decade ago. The foundations for the measurements of the retreat of the cataract were laid by Professor James Hall, when he made the first preserved instrumental survey of the cataract in 1842. Since then, measurements have been repeated in 1875 by the Lake Survey; in 1886 by Professor W. S. Woodward, and in 1890 by Mr. Aug. S. Kibbe. From these surveys the mean rate of modern recession of the falls is found much more rapid than was formerly supposed, as it amounts to 4.175 feet a year, and if the history of the falls had been uniform, then the age would have been only 9,000 years—not so different from the guess of half a dozen years ago, which took the maximum medial retreat of the cataract, and made the age only 7,000 years. Had the gentlemen taken the mean rate as then known, which the scientific methods dictated and since supported by the action of the river, they should have made the age of the falls 11,000 years, near which estimate some did. This point is noticed on account of many secondary writers finding the number 7,000 years as agreeable to their theories.

Owing to some structural variations, I have taken 3.75 feet a year as the mean rate to be adopted for the retreat of the falls mechanically applied to the different conditions of the river. These have been occasioned by the changing heights of the falls and the volume of the water. With regard to the latter point, it has been found that for three-fourths of the duration of the river, the drainage of Lake Huron and the upper lakes was by way of the Ottawa River, and not by way of Lake Erie and the Niagara. Under these conditions only $\frac{3}{11}$ of the present discharge of the Niagara River cascaded over the falls. The episodes of the river are as follows: First episode: water descending 200 feet, volume $\frac{3}{11}$ of the present (when the falls was of about the magnitude of the present American cataract), chasm excavated (as shown by the position of terraces) 11,000 feet; time required, 17,200 years. Second episode: descent of the river in a series of three cascades aggregating 420 feet at first with only the Erie drainage (during the recession of 3,000 feet) and afterwards the present volume of water (when the recession amounted to 7,000 feet) duration 10,000 years. Third episode: river descending 420 feet in one cascade with the present volume; time required, for the recession of 4,000 feet, only 800 years. Fourth episode was somewhat complicated, with the water mostly descending 320 feet, and during this condition the falls have receded 11,500 feet, and required a period of 3,000 years. Thus the age of the falls has been computed at 31,000 years. But at the beginning, the river flowed from lake to lake without a falls, and this time has been taken as 1,000 years; accordingly, the age of the river is computed at 32,000 years. The record of the changing levels may be seen in the deserted beaches now high above the lakes which have already been described in scientific journals. The investigations doubtless contain some errors which may be corrected in the future, but in the history of the lakes the present computations are very strongly confirmed by much cumulative evidence so that the present results appear to be approximately correct. It is further estimated that with the earth movements continuing as at present, the end of the falls will be effected by the change of the drainage from the Niagara River to the Mississippi, by way of Chicago, owing to the rise of the eastern rim of the Erie basin above the barrier now separating the lake waters from the Mexican drainage. With the present rate of elevation continuing, the future life of the river ought to be 5,000 or 6,000 years.

In regard to the relation of Niagara River to the Ice Age, I estimate that the lake epoch commenced from 48,000 to

64,000 years ago, and that for several thousands cf years before the birth of the river there was open water far northeastward of the river. Some writers think that the St. Lawrence Valley was obstructed by ice until a late date. This is a question to be determined; but however it may be, there has been free communication for the drainage of the Ontario basin for at least 14,000 years. Whether the end of the Ice Age were 60,000 or 14,000 years ago, all glacial obstructions had retreated to at least from 400 to 600 miles to the north and east of the Great Lakes fifty milleniums ago. The lake region was roamed over by mastodons, elks and beavers, but we do not know of the presence of man. If such be found, anthropologists will have all of these years to consider in fixing the antiquity of man. The story of Niagara River forms an interesting chapter in the physical growth of the lakes, and gives us an approximate idea of the duration of the lake epoch which was characterized by the last touches in the fashioning of the continent, and fixes the height of the Ice Age a very long time ago.

One point more should be noticed. An error has prevailed for fifty years in that it was supposed that the ancient Niagara drainage was by way of the Whirlpool, (St. David's) Ravine. This has been found erroneous, owing to the occurrence of rock across the Whirlpool Ravine at an elevation of about 170 feet above the surface of Lake Ontario.

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RECENT LITERATURE.

The Colorado Formation.[1]—This memoir by T. W. Stanton is published as Bulletin, No. 106 of the U. S. Geol. Survey. It comprises the descriptions and illustrations of all the species that can now be assigned to the fauna, thirty-nine of which are believed to be new to science. In an introductory chapter the author defines the Colorado formation, describes local sections, and gives faunal lists that show the vertical range and areal distribution of most of the species. This formation has been recognized by means of its characteristic fossils in Iowa, Minnesota, the Dakotas, Nebraska, Kansas, Colorado, Wyoming, Montana, Utah, Arizona and New Mexico. Equivalent strata exist in Texas and the adjacent regions, and over large areas in British America. As yet it is unknown east of the Mississippi, but it may have an equivalent on the Pacific coast, as one of its most characteristic fossils, *Inoceramus labiatus* is reported from the Upper shales and sandstones of the Queen Charlotte Island.

Mr. Stanton considers the fauna, as a whole, the taxonomic equivalent of the Turonian, as first pointed out by Cope.

The memoir is richly illustrated with 45 page plates of drawings carefully finished in detail.

Our Native Birds of Song and Beauty.[2]—This work by Mr. Nehrling is designed to awaken a love for nature among young people and particularly to interest them in bird-life so that they will not only protect it, but they will also study the habits and learn the haunts of birds with the view of fostering them by providing suitable nesting-places. It is issued in quarto form and the publishers have left nothing to be desired in the way of paper, type, and all that goes to present a book in an artistic form. The complete work will be a treatise on all the native North American Birds from the Thrushes to the Parrots. Vol. I, which is now at hand, carries the reader through the Swallows. An introductory chapter contains brief remarks on birds prized for their song or beauty, their habits, migration, their utility, their enemies, their protection ; and the acclimatization of exotic birds. Then follow

[1] The Colorado Formation and Invertebrate Fauna. By T. W. Stanton. Bull. of the U. S. Geol. Surv., No. 106. Washington, 1893.

[2] Our Native Birds of Song and Beauty. Vol. I. By Henry Nehrling. Milwaukee, 1893.

descriptions of species and with each description the author gives an account of the habits and habitat, based chiefly on his own observations. In every case the local name is given in addition, and no effort is spared to combine scientific accuracy with popular diction. The plates by Ridgway and Mützel are admirable specimens of color printing.

Cartailhac's Prehistoric France.[3]—This work forms one of the Bibliothéque Scientifique Internationale Series, and like the rest of that set aims to embody the leading facts of the subject treated in brief essay which shall be at once both popular and scientific. M. Cartailhac's opening chapter is a history of the progress of the science of archeology, and contains a resumé of the important discoveries made in France. Then follows a discussion of the evidence for the existence of preglacial man, and a presentation of the undoubted facts concerning his appearance during early Plistocene. Under the head "artistic manifestations," are described the drawings and sculptures by primitive man, and the conclusions drawn from a comparison of the work with that of uncivilized man of the present day. A chapter on human bones discovered in the Alluvium and another on the mortuary customs as evidenced by the position, condition and surroundings of the skeletons discovered in caverns and burial-places closes the history of Paleolithic man.

Of Neolithic man M. Cartailhac makes a longer story. The grottoes, both natural and artificial, used as sepulchres, and the strange megalithic crypts, are very fully described, together with the funeral rites of the ancient Gauls. Ethnographic comparisons are made with living races, particularly as to the custom of erecting stones as monuments. Finally a discussion of the type of Neolithic man as revealed by the Cro-Magnon and other skulls found within the last few years brings to a close this interesting work on prehistoric man.

The volume forms one of the series edited by M. Lanessan, and it is of importance as furnishing a review of what has been discovered in that richest of all fields, France.

Report of the U. S. National Museum for 1892.[4]—This report comprises the Reports of the Assistant Secretary of the Smithsonian Institution upon the condition and progress of the Museum; Reports of the Curators; Paper's illustrative of collections in the Museum; A Bibliography; and List of Accessions. Shufeldt's Paper on scientific

[3] La France Préhistorique d'aprés les Sépultures et les Monuments. Par Emile Cartailhac. Paris, 1889.

taxidermy is beautifully illustrated. The author criticises the results attained by workers in the Museum, viewing the subject from the standpoint of an artist and biologist. Other important and interesting papers are Dr. White's discussion of Biology in its relation to geological investigation, and a description of Japanese Wood-cutting and Wood-cut Printing by T. Tokuno, chief of the Bureau of Engraving and Printing of Japan. This paper is also finely illustrated.

Marsh on Tertiary Artiodactyla.[5]—In this paper we have another characteristic production of its author. Thirteen alleged new species, three alleged new genera, and three alleged new families, are named. To point out how far they are described, and are not duplications of other work, is the object of the following pages. The three "new" families are not described at all, not a single character being assigned to any of them. No reasons are given to show that they differ from each other or from families already known. The three new genera are described, but are not compared with genera already known out of North America. One of them (Agriomeryx, p. 270) is identical with the Coloreodon Cope, described in 1879[6] and figured in 1884 and 1888[6]. In addition to these three genera, references are made to nine other alleged genera named by the author in previous publications. Taking these up seriatim, the first in order is called Eohyus, which name was used without accompanying description in an address delivered by Prof. Marsh and published in 1877. The introduction of this and other new names in this way in that address gave them no authority, and other names applied to the same types at subsequent dates, if accompanied with a description, would necessarily be used. But if not so replaced, this rehabilitation after seventeen years, should be such as to satisfy the rules of nomenclature. But what is now offered to us? The only diagnosis of Eohyus vouchsafed to us, is that "the type specimen is a last upper molar and the characters of its crown are well shown in the figure," which accompanies the text. This will scarcely do as a generic diagnosis, and no other specimens represent the species and genus! Yet on the strength of this material he bases the "new" and undefined "family Eohyidæ." The specimen comes from the Wasatch of New Mexico. He then describes most imperfectly, and without figure, an alleged second species from the Puerco formation,

[4] Report of the U. S. National Museum for the year ending June 30, 1892. Washington, 1893.

[5] Description of Tertiary Artiodactyles by O. C. Marsh. Amer. Journ. Sci. Arts, 1894. Sept., p. 259.

[6] Proceedings American Philosoph. Society.

which he, as usual, calls the lower Wasatch, (again in defiance of the rules) thus assuming that a genus of this group is common to the two formations, an assumption only to be made on far better evidence than is here offered. He next states that the name of the Puerco genus Periptychus Cope is "preoccupied," but does not point out how or where. Scudder's Index shows that a division (not a genus) of Lepidoptera has been called Periptyches, which is not preoccupation. The entire proceeding is an attempt to make something out of nothing and is unworthy of a place in a scientific Journal.

The next genus mentioned is called Parahyus Marsh, which name was given in 1876. Osborn has regarded it as identical with Achænodon Cope, 1873, and no characters have been assigned which will distinguish them. The next name is Homacodon, which was given by Marsh without generic diagnosis in 1872. Two "new species" are named, but not described, but they are supposed to be introduced to science by figures of two astragali! The author asserts that the genus which I described, also in 1872, under the name of Pantolestes, includes species of "Homacodon." As the type of Pantolestes is from the same horizon as Marsh's specimens, it is probable that Homacodon is a synonym of that genus. If so, the superior molars are quadritubercular, since Marsh so figures them in the present paper. It is, therefore necessary to give the tritubercular form from the older Wasatch horizon another name. For this genus, whose type is the *Pantolestes brachystomus* Cope, I propose the generic name of Trigonolestes. The proper description of the *Homacodon vagans* by Marsh in 1872 would have prevented the reference to the same genus of the Wasatch forms in 1884.

The next genus proposed is Nanomeryx, which is defined. The type and only species is called *N. caudatus*, but is not described, except by the statement that it is half as large as the *Pantolestes* (*Homacodon*) *vagans*, and by reference to figures of the inferior end of the tibia, and the astragalus. Rather hard lines for paleontologists who shall hereafter desire to identify the species! We next reach the so-called genus Helohyus, which Marsh on a previous occasion alleged to be identical with Phenacodus. He does not repeat this statement in this paper, but says that it is suilline and therefore a member of another order. Two figures show that the two forms are also very distinct as to dentition. The name was originally proposed by Marsh in 1872 without generic diagnosis, and no diagnosis is given now, so that the field is still open to any one who may be able to properly characterize it. The abortion of another generic name given by himself by its union with "Helohyus," is a step made by the author in the right direction.

Our author next enumerates certain selenodont Artiodactyla from the Eocene system. Here we have an attempt to rehabilitate three generic names, enumerated, but not sufficiently or not at all described in the address of 1877 before referred to, and without mention of type species. The first of these (Eomeryx) has been since well described by Scott and Osborn, (in 1889), who show that the form is allied to Oreodon. Their name, (Protoreadon), has the right of first description and should be retained. The next genus, Parameryx, is described sufficiently to ensure its adoption, if it is distinct from the various allied European forms, with which, as usual, no comparison is made. The species ("*P. laevis*") is not described, but future students are expected to identify it from two figures, one of an upper molar, and the other of the astragalus. A second supposed species is very insufficiently described. Unfortunately for the adoption of the name Parameryx, the genus was, according to Marsh, described by Scott and Osborn in 1889 under the name of Leptotragulus. This publication contained the first description of the genus, hence the latter name must be retained. The third name of the address was "Oromeryx." It was not described, nor was any type species mentioned. The omission as to description is now supplied, but specific and family characters are confused by being mixed with the generic.

Under the head of Miocene Artiodactyles, we find the genus Coloreodon Cope redescribed under the name of Agriomeryx as already noted. The only species named is not described, but a part of the skull is figured, which does not offer any difference of specific value from the *C. ferox* Cope. The next form referred to is the suilline genus named but not described by Marsh in 1875 as Thinohyus. It has been impossible hitherto to locate this genus from Marsh's paper, but the figures of a few molar teeth now given throw some light on the subject, but as hitherto, no distinct description of the genus is given. Next follows a fuller description than usual of a new species of Leptochoerus Leidy. The author says that the molar teeth resemble those of the alleged genus Helohyus, but the figures show that they are very different. A suspicion of this seems to have been present to the author, who proposes to place the genus in a new family the "Leptochoeridæ," which as usual, he does not characterize. The last feat of Prof. Marsh which I shall notice, is that of naming a supposed new species of Procamelus on a figure of the calcaneum only! He states that the bones were found in the Pliocene of the John Day region of Oregon, meaning probably Loup Fork. Pliocene beds do not contain the genus Procamelus.—E. D. Cope.

General Notes.

MINERALOGY.[1]

Crystallization of Enargite.—Pirsson[2] has studied enargite from two new Colorado localities, viz., the Ida Mine, Summit District, and the National Belle Mine, Red Mountain. At the former locality the mineral is deposited in cavities left after the kaolinization of feldspar phenocrysts in porphyry. These crystals are tabular parallel to $\infty \bar{P} \bar{\infty}$, and are bounded by the forms $\infty \bar{P} \bar{\infty}$, oP, ∞P, and $\infty \bar{P} 2$. At the latter locality two types of crystals are found. One of these is in thick, striated prisms bounded by the same forms as the Ida Mine crystals and sometimes in addition $P \breve{\infty}$, $\bar{P} \bar{\infty}$, $\infty \bar{P} \frac{3}{2}$, and another brachydome. The second type of crystals from this locality is tabular parallel to the base and shows hemimorphic development. The forms observed on this type are oP, $\infty \bar{P} \bar{\infty}$, ∞P, $\infty \bar{P} 3$, $P \breve{\infty}$, $\frac{3}{4} \bar{P} 3$.

Crystallization of Scolecite and Meta-scolecite.—Rinne[3] has investigated crystals of scolecite from Iceland and shown that the mineral crystallizes in the rare inclined-faced hemihedral division of the monoclinic system. This fact was developed by etching and by study of the pyroelectric properties. The front faces of the prism have different etched figures from the rear faces, while in twinned crystals with the twinning plane the ortho-pinacoid, front and rear faces of the prism have the same figures. In simple individuals the front and rear faces are pyroelectrically positive and negative poles respectively. In twinned crystals all prism faces are positive and a negative zone follows the twinning line on $\infty P \breve{\infty}$ with neutral bands on either side.

When crystals of the mineral are heated much above 120° C they become cloudy, and the crystal structures seems at first sight to be lost, but by brightening up in oil it is found that a molecular rearrangement has taken place. This new mineral Rinne calls metascolecite. The inclined-faced hemihedrism of the monoclinic system is retained, but a remarkable revolution of the molecular groups through

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2]Am. Jour. Sci., (3) xlvii, pp. 212–215.

[3]Neues Jahrb. f. Mineral., etc., 1894, II, pp. 51–68.

an angle of 90° about the 'c axis has taken place. The ortho-pinacoid has become the clino-pinacoid and vice-versa. The twinning plane of twinned crystals has undergone the same revolution. By heating crystals beyond the temperature required for producing the first meta-scolecite, the double refraction of the substance steadily decreases and the symmetry approaches more and more closely to the orthorhombic. Below red heat the structure breaks down. As scolecite possesses three molecules of water of crystallization, Rinne suggests that the first meta-scolecite contains two, the second one molecule of crystal water, the crystal structure being lost when all the water has been removed.

Crystallization of Herderite.—Penfield[4] has made a study of herderite from the known localities as well as from a newly discovered locality at Paris, Me. The herderite from the latter locality as well as that from Hebron, contains scarcely any fluorine, its place being taken by hydroxyl, and the author proposes for it the name hydro-herderite. As the Stoneham herderite contains hydroxyl and fluorine in the proportions of 3 : 2, the one apparently replacing the other isomorphically, the name hydro-fluor-herderite is proposed for such intermediate varieties between theoretical fluor-herderite and hydro-herderite. In the crystallographic study the fact is brought out that the mineral is monoclinic instead of orthorhombic as has been supposed. This is proven not alone on Paris specimens but on specimens from the other localities, which were reexamined for this purpose. The crystals, however, approach closely to the orthorhombic system, the hydro- fluor-herderite being more nearly orthorhombic than the hydo-herderite, the substitution of fluorine for hydroxyl tending to increase the crystallographical axial angle and to shorten the clino-diagonal. It likewise diminishes the mean index of refraction and the optical angle.

Composition and Related Physical Properties of Topaz.—Jannatsch and Locke[5] have shown that topaz contains water of constitution, from a chemical study of specimens from San Louis Potosi, Ilmen Mts., Schneckenstein, and Brazil. Penfield and Minor[6] have independently established the same fact by a larger number of analyses, and shown how this greatly simplifies the formula of the mineral on

[4]Am. Jour. Sci., (3) xlvii, pp. 329–339.
[5]Am. Jour. Sci., (3) xlvii, pp. 386-387.
[6]Ibidem, pp. 387–396.

the assumption that hydroxyl and fluorine are isomorphous. Their results show that whereas the ratio $SiO_2 : Al_2O_3$: F varies from 1 : 1 : 1.50 to 1 : 1 : 1.84, the ratio $SiO_2 : Al_2O_3$: (F. OH) is constant and 1 : 1 : 2, so the formula of topaz becomes $(Al \cdot [F. OH])_2 SiO_4$ or $(Al [F. OH]_2) Al SiO_4$. Their study of the physical properties of the mineral establishes a definite relation between them and the per cents of fluorine and water present, clearly indicating the isomorphous character of the fluorine and hydroxyl. The hydro-topaz has the smaller optical angle and the smaller specific gravity. The same fact is brought out by the determined values for α, β, and γ, and by exact measurements of interfacial angles. The optical anomalies of some Brazilian crystals are explained by zonal growth of topazes of different composition.

Composition of Chondrodite, Humite, and Clinohumite.— Penfield and Howe[7] have undertaken the study of the composition of the members of the humite group with the result not only of bringing order out of chaos, but also of establishing the fact that chondrodite, humite, and clinohumite constitute an homologous series both in a chemical and in a crystallographical sense. Sjögren has assumed that fluorine and hydroxyl are isomorphous, and derived new formulas for the members of this series, but as the authors point out the older analyses which Sjögren utilized are low as regards water, and Sjögren neglected to take into account the replacement of magnesia by ferrous iron and the consequent lowering of the silica percentage. The formulas derived by the authors, reckoning ferrous iron as magnesia, are as follows:

Chondrodite	$Mg_3 (Mg [F. OH])_2 (SiO_4)_2$
Humite	$Mg_5 (Mg [F. OH])_2 (SiO_4)_3$
Clinohumite	$Mg_7 (Mg [F. OH])_2 (SiO_4)_4$

The common difference of this homologous series is a molecule of chrysolite, $Mg_2 SiO_4$. As shown by Sacchi and vom Rath, if the 'c, axis of crystals of chondrodite be divided by 5, that of humite by 7, and that of clinohumite by 9, the axial ratios of the three minerals become practically identical. Now these divisors, 5, 7, and 9, are the same as the number of magnesia atoms in the formulas of the corresponding minerals. A most interesting relation is thus brought out connecting the crystal forms and chemical compositions of the members of this group. The authors think it probable that other members of this series will be discovered, such as a mineral of the composition $Mg (Mg [F. OH])$,

[7]Am. Jour. Sci., (3) xlvii, pp. 188–206.

SiO_4. This compound should have either orthorhombic or monoclinic symmetry, with β equal to 90° and an axial ratio a : b : c=1.086 : 1 : 1.887.

Leucite from New Jersey.—Kemp[8] argues for the presence of partially decomposed leucites in a dyke rock at Rudeville, Sussex Co., N. J., from a micro-chemical test indicating the presence of potassium, and from remains of leucite twinning, in spheroids now largely made up of analcite, calcite, feldspar, and other supposed secondary products.

Variscite from Utah.—Packard[9] gives an analysis of a specimen of compact or cryptocrystalline variscite from a quartz vein near Lewiston, Utah. The analysis is as follows:

H_2O 22.95 P_2O_5 44.40 Al_2O_3 (By difference) 32.65.

Utilization of Auerbach Calcite for Nicols.—An attempt has been made[10] to utilize the clear calcite from Auerbach on the Bergstrasse, Germany, for Nicol's prisms. Four ordinary Nicols with inclined end faces were prepared by Schmidt & Haensch of Berlin, and although these are equal to the medium quality Nicols prepared from Iceland spar in the matter of extinction, they nevertheless contain inclusions, air bubbles, etc., which are visible even to the naked eye. Dr. Hoffman, the owner of the Auerbach quarries, still hopes to secure material pure enough to take the place of Iceland spar. The material already tested will suffice for technical purposes.

Crystallization of Willemite.—Willemite has been supposed to have rhombohedral tetartohedral symmetry from the similarity of its rhombohedral angles to those of phenacite. Penfield[11] studies crystals from the Merritt Mine, N. M., Sedalia Mine, Salida, Col., and Franklin, N. J. In the specimens from the first and last mentioned localities, rhombohedrons of the second and third orders were observed and measured, showing that the system is what has been supposed. On the crystals from the Merritt Mine the second and third order rhombohedrons are $\frac{\frac{2}{3}P2}{4}\frac{l}{r}$ and $\frac{\frac{3}{5}P\frac{3}{2}}{4}\frac{r}{l}$ respectively. One of the types from the Franklin Mines is terminated by a third order rhombohedron $\frac{3P\frac{3}{2}}{4}\frac{l}{r}$ alone, thus resembling the phenacite crystals from Mte. Antero, Col.

[8]Am. Jour. Sci., (3) xlvii, pp. 339–340.

[9]Am. Jour. Sci., (3) xlvii, pp. 297–298.

[10]Zeitschrift für Instrumentenkunde, 14te Jahrgang (1894), p. 54.

[11]Am. Jour. Sci., (3), xlvii, pp. 305–309.

The author shows that the cleavage of willemite is like that of troostite, indistinct cleavages parallel to both the base and prism being made out in willemite.

Composition of Staurolite and Arrangement of its Inclusions.—Exceptionally pure material for analysis was obtained by Penfield and Pratt[12] from St. Gothard, Switz., Windham, Me., Lisbon, N. H., and near Burnsville, N. C. A powder of uniform specific gravity was obtained in each case by the use of fused silver nitrate as a separating fluid in a specially constructed apparatus, the heavier and lighter portions of the powder being in this way removed. Reckoning MnO and MgO as FeO, and Fe_2O_3 as Al_2O_3, the four specimens yield results that agree well and indicate clearly that staurolite has the empirical formula $H\ Al_5\ Fe\ Si_2O_{13}$ as already suggested by Groth. The silica alone does not agree closely with this formula, being in every case about one per cent too high, and the authors think that this is due to the presence of inclusions of quartz too minute to be separated from the powder. Carbonaceous inclusions are in the staurolite from Lisbon, N. H., arranged in the same manner as in chiastolite crystals. The explanation of the authors is that the crystals of staurolite in growing in a solid rock, find it difficult to exclude foreign substances, the tendency to include them being greatest at the crystal edge and greatest where the interfacial angle is largest.

Determination of Quartz and the Feldspars in thin Section.—Sometime since Becke described a method of distinguishing quartz from feldspar by treatment with hydrochloric acid and subsequently tinting. He now[13] applies the same method to distinguish orthoclase from plagioclase and to determine the particular plagioclase species. Orthoclase is less affected by acid than plagioclase, and the soda rich plagioclases are less affected than the lime rich species. In rocks containing quartz, orthoclase and plagioclase, the slide is etched until by tinting the plagioclase shows an intense color. The orthoclase will then be faintly tinted and the quartz entirely unaffected.

Continuing his study Becke[14] has devised methods for the same determinations based on differences of refractive index. The first method consists in the examination of a perpendicular contact plane between

[12]Am. Jour. Sci., (3), xlvii, pp. 81-89.

[13]Tscherm. min. u. petrog. Mitth., xii, Heft 3, p. 2 (Notizen).

[14]Sitzungsber. d. k. Akad. d. Wissensch. i. Wien, Math. Naturw. Classe, Bd. II, Abth. I, pp. 358–376, July, 1893.

the two minerals with a cone of illumination of small angle. When properly focused, this contact appears as a sharp line. On raising the tube of the instrument, the focus is disturbed and a light band appears on the side of the contact toward the more refractive mineral, which band widens and finally fades out as the tube is raised higher. If, on the other hand, the tube be lowered, the same phenomena appear on the other side of the contact. The best results are obtained with the use of high powers and with a cone of illumination of small angle. Becke recommends the use of the *Irisblende* furnished with the newer instruments of Fuess. I have obtained good results with a small Voigt and Hochgesang instrument by removing the weak convex lens which covers the polarizer. Becke's *Schlierenmethode* makes use of inclined illumination, which is obtained with the *Irisblende* or with Abbe's *Beleuchtungsapparat.* With inclined illumination, that side of a section of strongly refracting mineral toward the direction from which the light comes, shows a light band against the less strongly refracting mineral surrounding it, while the opposite side shows a dark band. The author states that this method suffices to determine orthoclase, quartz, and a plagioclase when they are present together in a holocrystalline rock, but suggests that it be supplemented by the *Färbung* method. The method of determining the species of plagioclase depends on the comparison of the double refraction of the feldspar with that of quartz sections. By making per cents of *An* the abscissæ, and indices of refraction the ordinates, curves are obtained for α, β and γ within the feldspar series. These curves are intersected by the horizontal curves of ω and ε in quartz. If now α' and γ' be the less and the greater values respectively of the refraction for the two principal directions in any section of plagioclase, α' being between α and β and γ' between β and γ, the curves obtained indicate the follow ing relations:

	Parallel Position		Crossed Position		Composition.
I	$\omega > \alpha'$	$\varepsilon > \gamma'$	$\omega > \gamma'$	$\varepsilon > \alpha'$	Ab —$Ab_8\,An_1$
II	$\omega > \alpha'$	$\varepsilon > \gamma'$	$\omega = \gamma'$	$\varepsilon > \alpha'$	$Ab_8\,An_1$—Ab_3An_1
III	$\omega = \alpha'$	$\varepsilon > \gamma'$	$\omega < \gamma'$	$\varepsilon > \alpha'$	$Ab_3\,An_1$—Ab_2An_1
IV	$\omega < \alpha'$	$\varepsilon = \gamma'$	$\omega < \gamma'$	$\varepsilon > \alpha'$	Ab_2 An—$Ab_3\,An_2$
V	$\omega < \alpha'$	$\varepsilon < \gamma'$	$\omega < \gamma'$	$\varepsilon = \alpha'$	$Ab_3\,An_2$—Ab An_1
VI	$\omega < \alpha'$	$\varepsilon < \gamma$	$\omega < \gamma'$	$\varepsilon < \alpha'$	$Ab_1\,An_1$—An_1

It is seen that these subdivisions of the plagioclases correspond in a general way to the earlier one of Tschermak, I being albite, II and III oligoclase, IV and V andesine, while VI includes labradorite, bytounite and anorthite. As Tschermak's later and more equable subdivision of the series has not been generally accepted, Becke thinks the harmony between his natural table and the older scheme of Tschermak a reason for retaining the original classification. The practical method of utilizing the results in his table, consists in finding contiguous sections of quartz and plagioclase which extinguish nearly parallel to one another. By means of the quartz wedge it is then determined whether the double refraction of these sections is of the same or of opposite sense. If the former, they are said to have parallel position and will indicate some of the relations of the first column of the table, and, if the latter, they have crossed position and their relations will correspond to something in the second column of the table. The quartz section always yields ω and a value varying but little from ε.

This method applies only to holocrystalline rocks which contain quartz, but it is a discovery of much importance which will doubtless be of much service in the study of the crystalline schists. The author has applied the method to the determination of the feldspar in many rocks of the Rosenbusch collection of B. Stürz, and printed his list of determinations. An excellent photogram also accompanies the paper.

Fluid Enclosures in Sicilian Gypsum.—The Cianciana gypsum contains cavities filled with liquid, some of which are 3 cm. in extent. Sjögren[15] has analyzed the liquid with the following results:

K_2O	Na_2O	CaO	MgO	Cl	SO_3	Total	O deducted for Cl_2	Cor. Total
2.1	40.9	4.1	3.9	44.9	14.1	110.0	10.1	99.9

Corresponding to

K_2SO_4	Na_2SO_4	$CaSO_4$	NaCl	$MgCl_2$	Total
3.7	11.4	9.7	66.2	9.0	100.0

The saline constituents were 4.023 per cent of the solution. This fluid is a fossil water of Miocene age, and differs from ocean water chiefly by containing a greater percentage of sulphates. It agrees fairly well with the water of some sulphur springs. The author thinks that the quantity of sulphates present in the water of the enclosure shows that the gypsum and sulphur cannot have been derived from a lagoon of sea water in which organic matters have reduced sulphur from the contained sulphates. Whether they are the product of sulphur springs or of emanations of H_2S in a lagoon of sea water in which sulphur has been deposited and sulphates formed by action of SO_3 on marls, the author is unable to determine.

[15] Bull. Geol. Inst. Upsala, I, (1893), No. 2, pp. 1–7.

New Sulphostannate from Bolivia.—In 1893 Penfield described a new isometric germanium mineral from Bolivia, which had the formula Ag_8 Ge S_6, and which he named canfieldite. This he showed to be identical chemically with Winkler's Freiberg mineral argyrodite, which that chemist had given the formula Ag_6 Ge S_5 and which Weisbach had considered monoclinic. Weisbach has since found that his earlier determination of the symmetry was incorrect, it being isometric tetrahedral and identical with the Bolivian mineral which should hence bear the name argyrodite. Penfield now transfers the name canfieldite[16] to a new sulphostannate of silver from La Paz, Bolivia, having isometric symmetry. A part of the tin is replaced by Germanium. The formula of the mineral is Ag_8 (Sn Ge) S_6, argyrodite being Ag_8 Ge S_6. The two minerals have similar physical properties, and are evidently isomorphous.

Allanite from Franklin Furnace.—Eakle[17] has made a crystallographical study of the allanite from the Trotter Mine, Franklin Furnace, N. J. The crystals occur in a granite dike associated with zinc ores. They are variable in habit and exhibit in all fourteen forms, none of which are, however, new to the species. The same author describes the tourmalines[18] from Rudeville and Franklin Furnace.

Miscellaneous.—Model[19] has found molybdenite and molybdite in the serpentine of the Rothenkopf, Zillerthal—. Carnot[20] has made an examination of the composition of wavellite and turquoise. In four analyses of wavellite from Cork, Ireland; Clomnel, Ireland; "Chester, Etats unis" (probably from Pennsylvania); and Garland, Arkansas, the fluorine was found to be 1.90, 2.79, 2.09 and 1.81 per cents respectively. Carnot proposes for the mineral the formula $2\ (P_2O_5\ Al_2O_3)+Al_2\ (O_3F_6)+13\ H_2O$, but in the light of the recent work of Penfield, it seems more probable that part at least of the water present, is water of constitution, and that the fluorine replaces hydroxyl and not oxygen. In two specimens of turquoise of mineral origin (from Persia and Nevada respectively) no fluorine was found. Two specimens of occidental turquoise (odontolite) yielded each over three per cent of fluorine. The entrance of fluorine into odontolite during its derivation from fossil teeth, the author was led to expect from his study of the composition of fossil bones of the different geological ages.

16Am. Jour. Sci., [3], xlvii, pp. 451–4.
17Trans. N. Y. Acad. Sci., xiii, p. 102; also Am. Jour. Sci., [3] xlvii, pp. 436–8.
18Am. Jour. Sci., [3], xlvii, p. 439.
19Tscherm. min. u. petrog. Mitth., xiii, p. 532.
20Comptes rendus. cxviii, pp. 995–8.

GEOLOGY AND PALEONTOLOGY.

Origin of the Trilobites.—A study of the appendages of Trilobites leads Dr. Walcott to views confirmatory of those of Bernard in regard to the origin of the Trilobites. Dr. Walcott considers the modern Crustacea as "descendants of the Phyllopod branch, and the Trilobita form a distinct branch." (Geol. Mag., May, 1894).

Bernard's lastest communication on the subject, is to the effect that the great variability in the number of segments shown by Trilobites, the formation of the head by the gradual incorporation of trunk segments, the bending round ventrally of the first segment, the "wandering" of the eyes, the existence and modification of the "dorsal organ," and especially the character of the limbs, all serve to connect the Trilobites with *Apus*. That *Apus* lies low in the direct line from the original annelidan ancestor towards the modern Crustacea, and the Trilobites probably branched off laterally from this line, anterior to the primitive *Apus*, as forms specialized for creeping, with the protection of a hard imbricated carapace. This carapace resulted from the repetition on trunk segments of the pleurae of the head segments, which together form the head shield. (Proceeds. London Geol. Soc., March, 1894).

Some New Red Horizons.—A survey of Montgomery and Bucks Counties in Pennsylvania, has shown that the New Red in the former county is 27,000 feet thick. This unexpected result harmonizes with the recorded facts in other States. A study of this region has been made by Dr. B. Smith Lyman with the view of a better understanding of the relative geological position of the different horizons from which fossils have been reported in the "so-called American New Red" of the eastern part of the United States. Mr. Lyman recognizes in the Montgomery series five distinct horizons which he names and defines as follows, beginning with the oldest:

Shales mostly soft and red, but in small part dark gray or green, or blackish with beds of brown sandstone, and of gray sandstone and pebble rock, at Norristown and eastward, about 6,100 feet; Norristown Shales.

Shales, in great part hard, dark or greenish-gray and blackish, partly dark red, at the Gwynedd and Phœnixville tunnels, with traces of coal, about 3,500 feet; Gwynedd Shales.

Shales, mostly soft and red, at Lansdale and near it, about 4,700 feet; Lansdale Shales.

Shales, in great part hard and green, partly blackish and dark red, with some small traces of coal at the Perkasie tunnel and near it, about 2,000 feet; Perkasie Shales.

Shales, mostly soft and red, at Pottstown and northeastward, about 10,700 feet; Pottstown Shales.

The author then, from fossil records, traces these horizons in other Atlantic border States. In Maryland he finds the Gwynedd and Lansdale Shales represented. In Virginia, while the total New Red thickness is not so great as in Pennsylvania, there seems to be all five divisions represented. The North Carolina fossils all appear to belong to the Gwynedd Shales. In New Jersey the divisions are traced quite across the State with the exception of a dozen miles north, south and west of Somerville where the indications are not quite certain. In this State it is noticeable that the thickness of the New Red diminishes toward the northeast, and the variation is due to the absence of the upper beds, The diminution extends into Connecticut in greater degree, and still more so in Massachusetts. Almost all of the fossils in these two States represent the Gwynedd Shales. A list of all the recorded New Red fossils, arranged by the author according to the different horizons, facilitates comparison.

Mr. Lyman concludes his valuable contribution to geological literature with the following remarks:

"It is not improbable that the Norristown Shales, with the great calamite near Doylestown, the apparent Lepidodendron at Newark and Belleville, and the Palaeophycus at Portland, may after all prove to be at least as old as the Permian. It seems highly probable that the well ascertained great thickness of 27,000 feet in Montgomery County should represent more than one limited paleontological period, and not only that it should include the Permian, but that the very extensive upper third of that space, hitherto almost devoid of reported fossils, should turn out to be much newer than the Triassic. Those upper beds have also shown here and there imperfect fossil traces, and as there are occasional beds of green shale among the predominant red ones, there is reason to hope that more abundant and perfect fossils may some day be found."

As for the trap, the author thinks it impossible to doubt that all the conformable trap sheets are overflows contemporaneous with the sedimentary beds, and not subsequent intrusions. (Proceeds. Amer. Philos. Soc., Vol. XXXIII, 1894).

The Gosau Beds in the Austrian Salzkammergut.—The extensive literature of the Gosau Beds is a proof of their importance from a geological point of view. Since 1832 this remarkable formation with its unique fauna has been under discussion among European geologists. In a paper published in the Quart. Journ. Geol. Soc., 1894, Mr. H. Kynaston brings together the results of previous investigation on the stratigraphy and paleontology of the Gosau Beds, and gives an account of his own observations made with reference to fixing their geological horizon. The beds are divided into an upper and lower group, the latter extremely fossiliferous, while the former is almost devoid of organic remains. On both stratigraphical and paleontological evidence, the author correlates the Lower Gosau Beds with the Turonian and Senonian of the south of France. These in turn represent the English Middle and Upper Chalks. The Upper Gosau Beds being non-fossiliferous, cannot be located definitely, but the probability is that they represent the Danian of other districts and are on the same horizon as the chalk of Maastricht and Aix-la-Chapelle.

Geology of the Rocky Mountains between the Saskatchewan and Athabasca Rivers.—During the summers of 1892 and 1893, some explorations were made in the Rockies between Howse Pass and the Athabasca Pass. This tract of mountains, including some of the grandest mountain scenery in North America, has been neglected by scientific observers, so that maps hitherto published represent it incorrectly. New lakes and rivers were discovered, heights of peaks determined, and paleontological collections made. The results of a geological reconnaisance of this region are summarized as follows by Professor A. P. Coleman:

"To sum up the geological features of the region examined, we may describe the southeastern portion, well displayed along the Brazean River, as consisting of a series of seven or more minor ranges, each striking northwest and southeast, and tilted 25°–45° toward the coast line of the Pacific. These blocks, consisting of thousands of feet of quartzite and conglomerate, often overlain by thousands of feet of Devonian limestones, appear to have been thrown into their present attitudes by a series of reversed faults, as described by McConnell in Bow Pass. The rare folds observed in this portion of the mountains represent, perhaps, the dying out of such faults. Though no Cretaceous rocks have been proved to overlie the Devonian strata, it is probable that the faulting which produced the mountains took place since Cretaceous times, for the foothills of Laramie sandstones give evidence of parallel faulting and tilting.

"On approaching the watershed of the Rockies west and northwest of the region just referred to, the regularity of the structure largely disappears. The direction and amount of dip vary, folds are not uncommon, and the rocks become more or less micaceous and metamorphosed; slates and sericite schists underlie the quartzites and conglomerates, and fossiliferous beds were not observed. The apparent absence of eruptive or plutonic rock is a feature worthy of note in a region where faulting has taken place on so huge a scale.

"The evidence of the action of Dr. G. M. Dawson's Cordilleran ice mass is distinct; the time which has elapsed since the Ice Age has been comparatively short, and the innumerable glaciers of the region represent the shrinking remnants of the ice sheet."

American Tertiary Aphidae.—It would hardly seem that plant-lice with their gauzy wings and soft bodies could be preserved in rocks. Yet they are not infrequently found. In Europe they are reported from four localities as well as from the Baltic amber. They have even been found in Mesozoic rocks. In America, Florissant, Colorado, has yielded 107 specimens, and they have been found at Green River, Wyoming, and Quesnel, B. C. The American Tertiary Aphidae have been described and figured by Dr. Scudder, and he has recently compiled a list of the species known, presenting them in a way to render their study compartively easy and their diversity apparent. In the introduction he states that but one immature plant-louse has been found fossil in America, all the others are winged and belong to 32 species, divided into fifteen genera, of which 11 fall into the Aphidinae, the remaining four, with only five of the thirty-two species, into the Schizoneurinae, which have but a single branch to the cubital vein.

A characteristic feature of the American Tertiary Aphidae is a peculiarity in the neuration which is found also in the only wing known from the Mesozoic rocks. This feature is the great length and slenderness of the stigmatic cell. As a rule also the wings are long and narrow and the legs exceedingly short. Mr. Scudder calls attention also to the extraordinary variation in the neuration of the wings, which is strikingly greater than among living forms. (Thirteenth Ann. Rept. Director U. S. Geol. Surv. for 1891–92).

The Restoration of the Antillean Continent.—The following paper was read before the Brooklyn meeting of the Geological Society of America. It is a difficult subject of unusual interest, and it promises to be epoch making in the department of dynamical and recent geology. Two previous papers by myself have been published by the Society upon topics leading up to the present investigations, which take into consideration the characteristices of the valleys both of the southern mountains and the coastal plains, and show how the valleys are directly due to atmospheric erosion. All of the land valleys become miles in width in their lower reaches, where they are buried by recent accumulations of sand, etc., to considerable depths. Off the coast there are broad submerged plateaus or terraces marking the pauses in the changes of sea level. Across these plateaus are numerous drowned *canons* or fjords shown to reach to very great depths. From their resemblance to the land valleys, they are regarded as of atmospheric or erosion origin, After passing the limits of the sands shifted by the coastal currents and filling the valleys, it may be said that every great valley has its fjord-like continuation through the submerged margin of the continental mass, even to depths of 10,000 or 12,000 ft. or more. From the natural inference that these valleys were formed above sea level, it would appear that the land had stood as high as the fjords are deep. But this statement is modified, for the movements have been in unequal undulations, the amount of which can often be calculated, and thereby the extreme depth has been reduced so that it seems that the former elevations of the West Indian region and adjacent parts of the continent may not have stood more than from 8,000 to 12,000 feet higher than now, according to the locality. The undulations of the earth's crust have been exaggerated by mountain folds in places, but in the great majority of the drowned valleys, such has not obtained for their direction is not parallel to the mountain ridges, but across that of the continental mass. Consequently there is no escape from the conclusion that the late continental elevation is measureable, but the movement has proved to be vastly greater than had hitherto been supposed, enough to change the whole physical geography of the region, the climate and the conditions of life. During the epochs of elevation, the Mexican Gulf and the Caribbean Sea were dry plains which extended to and were drained into the Pacific Ocean. The Antillean Islands formed a plateau-bridge connecting the two Americas.

At the close of the Miocene period, the Antillean and Central American lands were represented by only small islands. Then succeeded the Pliocene period during the earlier and mid portion of which the great elevation occurred. This was succeeded by the subsidence about the close of the Pliocene period, long enough to allow the accumulation of the Matanzas limestones (of Spencer), but in amount not exceeding a depression of from 100 to 1300 feet below the present level. There was a late Miocene mammalian fauna on the continent, but it did not extend into the Pliocene period, for no mammals of that date are known east of the Mississippi River. As the fauna flourished when the continent was at about the same altitude as now, the great change in elevation, causing the subtropical climate to become subarctic, may have been sufficient reason for the restriction of the earlier life, whose descendants would have been extinguished by the drowning of the now insular region and 250,000 square miles of the continent. Again the continent rose to an altitude about as great as that of the Pliocene days, when it suffered an enormous erosion. During this earlier portion of the Pleistocene period, there was a rich mammalian fauna of horses, elephants, tapirs, camels, etc., but these were exterminated by the succeeding depression which carried down the Antillean lands to the proportions of small insular masses, and reduced the plains of the northern continent by 150,000 square miles. Since that time there have been reëlevations and minor undulations, but no connection between the islands and the continent, so that the modern types of mammals have been unable to reach the West Indies.

The changes which have occurred in the West Indies and those of the adjacent portion of the continent have been nearly identical, but the movements in the Antillies appear to have been somewhat more energetic, and the geographical evolution of the continent is best studied from the West Indian phenomena, but neither region is complete without the other. The general problem could not have been elucidated until the investigations which I have made upon the fjords.

The connection of the Antillean waters with the Atlantic and the separation from the Pacific Ocean should be noticed. There was free communication between the two oceans about the close of the Miocene period. The Pliocene union of the two continents separated the two oceans, although there may have been an enclosed sea between Cuba and Jamaica. With the subsidence of the land at the close of the Pliocene period, there was only a narrow and shallow communication between the Antillean waters and the Pacific, but the connection with the Atlantic was more complete than now. These connections were again closed during the Plistocene elevation. With the depression of mid-Plistocene days, the Atlantic was again admitted to the Mediterranean Seas, and it is also probable that there were two or three shallow passages leading to the Pacific. During the later Plistocene and modern days there have been no change of level which have effected the oceanic connection. The changes of level have been of two characters; (*a*) the epeirogenic or continent-making movements, which produce broad but gentle undulations, depressing basins or raising up barriers, but not distorting the topographic features so as to render them unrecognizable, and (*b*) orogenic or mountain-making movements, which are most energetic over limited zones, and produce disfiguring barriers. Whilst the Antillean region was sinking with gentle undulations, the Central American mass was slowly rising, but it was farther deformed by the great mountain making movements and the late volcanic accumulations, which have completed the separation of the Antillean Seas and the Pacific Ocean.

The phenomena are extremely suggestive, and from the evidence brought out it appears that many problems of physical geology will need readjustment in the light of the changed continental condition, ocean currents, climate and distribution of life. The subject is important as a contribution to the structure of land features in their interpretation of geological history.

J. W. SPENCER.

The Drainage of the Great Lakes into the Mississippi River by way of Chicago.[1]—I now add another short chapter to the history of the Great Lakes. The highest beach south of Chicago is 45 feet above the lake and there are several beaches just above the present lake level. The divide between the lake and the Mississippi drainage is only eight feet above the lake, and this at a point 25 miles southwest of Chicago. The succession of beaches at the head of the lake has led to confusion, as there is an enormous lapse of time between, for the highest amongst the oldest shore lines of the later region from its level the lake shrinks to a plain 300 feet below, whilst the waters were being drained by way of the Huron Basin and the Ottawa River. Afterwards terrestrial deformation raised the northeastern river of the basins and turned the Huron waters into the Erie and Michigan basins, and for a time overflowed the Chicago divide, which became drained about 1500 years ago by the recession of Niagara Falls through Johnson Ridge. With the terrestrial deformation continuing as in the past, it is estimated that the drainage of all the upper lakes may be turned into the Mississippi in about 5000 or 6000 years.

J. W. SPENCER.

Geological News. GENERAL.—Professor T. C. Bonney calls attention to the possibility that a rock of igneous origin can be so

[1]Abstract of paper read before the American Assoc. Adv. Science.

changed by pressure and indirect consequences as to be readily mistaken for a compact and not very much altered sediment. He instances particular cases of schistose green rocks in the Alps which upon examination prove to be the result of crushing without shearing. The author suggests that modified igneous rocks may form a large part of the *Grüne Shiefer* of the Swiss geologists. (Quart. Journ. Geol. Soc., May, 1894).

ARCHEAN.—Evidence is presented by Mr. J. E. Spurr for correlating the Thompson slates, which occupy an extensive area in eastern Minnesota, with the Keewatin of the Mesabi Range rather than with the Animikie of that district. If the suggested correlation is correct, it will follow that the erosion interval between the Animikie and the Keweenawan was very great. (Am. Journ. Sci., Aug., 1894).

CENOZOIC.—M. L. Cayeux calls attention to the presence in the precambrian formations of Bretagne of Foraminifera of a relatively complex form associated with a large number of Radiolaria. The rocks which contain these organisms are quartzites and phtanites interstratified with the precambrians of Saint Lo. (Revue Scientif., 1894).

The discovery of certain fossil corals in Shasta and Siskiyou Counties in California, demonstrates the undoubted presence of middle Devonian deposits in that region. Notes on these fossils are given by Mr. Schuchert in Am. Journ. Sci., June, 1894, together with some correlations of the beds in which they were found with those of other regions. The Shasta County fossils are believed to indicate the Corniferous terrane as developed in New York, Kentucky, Michigan and Ontario. Those of Siskiyou County are of younger age, and agree in a few cases specifically with those of the Devonian of the White Pine Mining District in Nevada.

Mr. A. Smith Woodward records four new fossil fishes from the Karoo Formation. The descriptions are accompanied by plates showing the specimens natural size. Three of the fossils are Palaeoniscidae and the fourth belongs either to that family or to the Platysomidae. (Ann. Mag. Nat. Hist., 1893).

Newberry's genus, Spiraxis, is represented in the Devonian of Belgium. M. Stainer in describing this curious spiral fossil agrees with Newberry in supposing it to be the remains of a species of alga, and gives it the name *Spiraxis interstrialis*. (Bull. Soc. Belge de Geol. Pal.

et Hydrol., 1894). Dr. Hollick, however, shows that the bodies thus described are the casts of the spiral intestine of Cladodont sharks. (New York Acad. Sciences.)

MESOZOIC.—According to M. Lechien, the invertebrate fossils found in the bed from which the famous Ichthyosaur of Arlon was taken, indicate a formation belonging to the middle Lias instead of lower, as was at first supposed. (Bull. Soc. Geol. Bruxelles, 1894).

CENOZOIC.—The old theory first advanced by Shaler in 1870, of the origin of drumlins by a destructive process, that is, a working over of morainic or other drift deposits, have been revived by Prof. R. S. Tarr. He brings forward facts to support it, and discusses three objections to it, but concludes on the whole that this theory forms a good working hypothesis, even if it is not accepted as the most probable theory. (Am. Geol., June, 1894).

Mr. Warren Upham offers, as an explanation of the Plistocene climatic changes, the epeirogenic theory of the Ice age thought out and formulated by Dana, Le Conte, Wright, Upham and Jamieson. He conceives the Ice age to have been essentially one and continuous, with important fluctuations. Soundings off the West African Coast record a submerged channel of the Congo extending eighty miles into the ocean to a depth of more than 6,000 feet. Another deep submarine valley having soundings of 2,700 feet is known on the African Coast 350 miles north of the equator, and there is a similar valley in the southern part of the Bay of Biscay. These remarkable valleys beneath the sea level indicate that probably the entire Atlantic side of the Eastern Continent has been greatly uplifted within late geologic time. (Geol. Mag., Aug., 1894).

In regard to the "Black Earth" of Russia, Dr. W. F. Hume suggests (1) the position of Loess has been determined by the manner and conditions of its origin, and (2) Black Earth is merely a special closing feature in the sequence of a long history of Loess, and it is merely that deposit rich in humus resulting from the decomposition through long ages, of generations of grasses and steppe plants. (Geol. Mag., Aug., 1894).

The Yellow Gravel of New Jersey is made the subject of special discussion in the report of Prof. Salisbury upon the surface geology of that State. After giving its distribution and its history as inferred from its character and position, the author states that the study of this formation leads to the following conclusions:

(1) The original yellow gravel is Pre-plistocene. (2) The time of its deposition was followed by an epoch of elevation and extensive erosion of long duration. (3) Then came a period of depression during which the Columbia deposits were made, equivalent in age with the first glacial deposits. (4) Again an epoch of elevation and erosion, when the degradation and redistribution of the original formation went forward. (5) An epoch of slight depression. (6) Subsequent elevation to the extent of forty to sixty feet, followed by the present subsidence. (Ann. Rept. Geol. Surv. New Jersey for 1892).

ZOOLOGY.

Parthenogenesis among the Acari of Feathers.—In a communciation to the Entomological Society of France, Dr. Trouessart states that he has observed a parthogenetic manner of reproduction in the plumicolous Sarcoptidæ under such conditions as to preclude the possibility of mistake. In 1888 Dr. Trouessart described an Acarian, *Syringobia chelopus*, which is found in the tubes of the feathers of *Totanus calidris*, a bird of passage through France in the Spring and Fall. A study of the life history of this species has developed the following facts.

In the Spring little colonies of the Acarian are found in the tubes of the feathers of the migrating wader, evidently having wintered in those narrow quarters feeding on the pith of the feather. Their numbers are small rarely exceeding ten or twelve in each colony. The composition of the colonies is variable, but taking 25 or 30 of the principal feathers of the wing together there will be found the following eleven forms. (1) Eggs with a shell; (2) Naked eggs; (3) Normal larvæ; (4) Abnormal larvæ; (5) Normal nymphs; (6) Abnormal nymphs; (6) Sexually developed females or secondary nymphs; (9) Abnormal females; (10) Normal males or *heteromorphs;* (11) Abnormal males or *homeomorphs*. All of the forms are not found together in the same feather. The normal form and the abnormal form (which I have called *syringobia*) live in separate feathers, and the naked egg belongs to the latter form. The males in the abnormal series are very rare, only one or two for one hundred females in that series; while in the normal series the proportion is one male to three females. Neither normal males or eggs with a shell are found with the syringobial females. These lay naked eggs covered only with the thin hyaline membrane which forms the inner covering of the shelled eggs.

In a general way the syringobial form, is distinguished from the normal by its large cheliceres and by the thin, transparent skin over the posterior part of the body. The syringobial female is larger and more elongate than the normal type.

The skin left after the final moult, which transforms the syringobial nymph into an adult female, is totally wanting in the post-anal opening which corresponds to the copulatory pouch and which is perfectly plain in the secondary normal nymph or sexually developed female.

The life-history as traced by Dr. Trouessart proceeds as follows:

At the time of the autumn moult which preceeds the departure of the birds for the warm countries a certain number of young larvæ or nymphs of *Syringobia* penetrate the tube of the feather through the *ombilic supérieur.* Three or four are thus installed in each feather. If there is one or more males in the colony the development is normal, and the fertilized females lay shelled eggs. On the contrary, if there are no males, the female nymphs having attained the age of the secondary nymph, instead of being transformed into normal females continue growing until the body is nearly double the size of the normal secondary females, assuming more and more the characters of the syringobial form; then they undergo a final moult and are transformed into parthenogenic females laying eggs without shells. From these eggs are developed larvæ, which reproduce the parthenogenetic form during the migration of the bird. At the end of the journey, either immediately or during the stay in the warm region, the young issue from the two series (the normal egg and the parthenogenic egg), leave the interior of the feather and make their home on the plumage. In fact, Syringobia is found on the plumage of birds killed in the warm countries, but they are found in the feather only during migration.

Parthenogenesis, in this case, according to Dr. Trouessart is the result of the segregation of individuals and the death of males. It is probable that this phenomenon is more frequent in this group than has been hitherto supposed. (Bull. Soc. Entomol. Paris, 1894.)

Trionyches in the Delaware drainage.—Turtles of this family have been supposed to be absent from the Delaware drainage, but the two following instances show that this view is no longer tenable. In the latter part of August a specimen of the "soft shelled turtle" was captured in the Paulins Kill at Hainesburg, Warren, Co., N. J. and sent to the museum of the Wagner Institute by Mr. E. B. Allen. The mounted specimen measures as follows: Total length 18 inches. Length of carapace 12 inches, width 9 inches. Length of plastron 8 inches. The tough integument has shrunken somewhat and its true measurements exceeds these by about one inch. Color a dark brown, with black spots, many of these ocellate, under surface white, feet dark yellow irregularly marked with black.—CHAS. W. JOHNSON.

NOTE ON THE ABOVE—Two individual Trionychidæ were captured in a pond near Woodbury, N. J. about a year ago, and are now living in captivity. I have not seen them, but there is no doubt as to the fact.—E. D. COPE.

The Femoral Gland of Ornithorhynchus and Its Secretions.—At the July meeting of the Linnean Soc. N. S. W. a paper on the secretions of the femoral gland of the Ornithorhynchus was presented by C. J. Martin and F. Fidswell. The paper contained also notes of an experimental enquiry concerning the toxic action of these secretions.

The gland is described as belonging to the compound racemous variety with large alveoli possessing a wide lumen, and somewhat recalling the appearance of a mammary gland. The alveoli communicate with ducts which eventually join at the hilus of the gland to form the duct leading to the spur.

The gland is surrounded by a capsule of fibrous tissue, exterior to which is a thin layer of smooth muscle fibres. A marked difference in the minute structure of the gland was noted in animals killed in June and those in April respectively, the former showing the appearance characteristic of an actively secreting gland, whereas the latter suggested that of a mammary gland when it had undergone retrogressive metamorphosis.

Examination of the poison showed it to consist principally of albuminous bodies, and the introduction of these into rabbits produced very marked poisonous results. When injected under the skin, local swelling and general depression and rise of temperature followed, but in three days the animal was well again. When the poison was introduced directly into the vascular system, small quantities ($\frac{1}{3}$ grain) caused death in under half an hour. Larger doses so introduced produced almost immediate death, by producing nearly universal clotting of the blood whilst travelling in the blood vessels. Such clotting naturally soon put an end to all circulation.

In summing up, the authors compare the action of Ornithorhynchus poison with that of the venous of Australian snakes, supposing the latter to be diluted 5000 times. (Nature, Sept,, 1894.)

Change of Color in the Northern Hare.—From the study of 75 specimens of *Lepus americanus* collected for the express purpose of investigating the seasonal change of color, Mr. J. A. Allen arrives at the following conclusions:

(1) The change of color, both in autumn and in the spring, is due to change of pelage, and not to a change in the hair itself.

(2) The change is gradual, occupying many weeks.

(3) The method of change, as regards the parts first affected is the reverse in spring in the order characterizing the autumnal change.

(4) In the early part of spring, after the white overhair has been shed, the pelage consists of the heavy coat of soft winter underfur. This gradually disappears as the summer coat thickens.

(5) In spring the moult occurs quite as early and proceeds just as rapidly in the females as in the males, and the moult is practically completed before the young are born.

These conclusions differ widely from views hitherto entertained by both scientific and non-scientific writers. (Bull. Amer. Mus. Nat. Hist., 1894.)

Zoological News. MOLLUSCA.—The characters in the shell of *Nautilus pompilius*, described as sexual by J. Van der Hoeven, are believed by Messrs. Bather and Buckman to be due to age rather than to sex. In that case a strong point in favor of sexual dimorphism in Ammonite shells has lost its value. (Nat. Sci., Vol. VI, 1894.)

In a discussion of the geographic and hypsometic distribution of North American Viviparidæ, Mr. E. Call recognizes four genera, viz., Tulotoma, with two species; Lioplax, with two species; Vivipara, with four species; and Campeloma, with nine species. This arrangement is based upon the examination of several thousand specimens. Of these species, *Campeloma decisum* Say has the widest range and *Vivipara troostiana* the most restricted. The latter is abundant in a small stream near Murfreesboro, Tennessee, and there is no record of its being found elsewhere. Vertically, the most of the species lie between 100 and 700 feet altitude. Here again *Campeloma decisum* has the greatest range. (Am. Jur. Sci., Vol. XLVIII, 1894.)

CRUSTACEA.—A new species of Tanais (*T. robustus*) is described by Mr. H. F. Moore. It inhabits minute tubes in the crevices between the scales of the carapace of *Thalassochelys caretta.* (Proceeds. Phila. Acad. Sci., 1894).

A blind cray-fish from Florida is described by Dr. Lönnberg under the name *Cambarus acherontis.* The specimens we obtained from a subterranean rivulet struck about 30 feet below the surface of the ground in Orange County. They represent the fourth species of Cambarus found in the United States. (Zool. Anz., 1894.)

VERTEBRATA.—Dr. Boulenger describes 13 new species of fresh-water fishes from Borneo. They are referred to 9 genera of which one, Nematabramis, is new. Three species, *Nemachilus olivaceus*, *N. saravacensis* and an *Acanthophthalmus* are of special interest as the first Cobitines described from Borneo. (Ann. Mag. Nat. Hist., Vol. XIII, 1894.)

Prof. E. D. Cope has recently published a paper on Reptiles and Batrachians from Costa Rica in which he enumerates fifteen new species, distributed as follows; 1 Urodela, 4 Salientia, 3 Lacertilia, and 7 Ophidia. Among them are two new genera; Levirana, identical with Ranula, but without vomerine teeth, and Pogonaspis, more nearly allied to Tantilla than to any other genus, but differs from it in the large single genial plate. (Proceeds., Phila. Acad., 1894.)

A preliminary list of the Reptiles and Batrachians of the Island of Trinidad prepared by Messrs. Mole and Urich shows a total of 76 species distributed as follows: Tortoises 6; Lizards 25; Snakes 33, Batrachians 12. Of these species 21 are recorded for the first time from the Island and two are new to science. The latter are described by Boettger under the names *Sphœrodactylus molei* and *Hylodes urichii* (Journ. Trinidad Field Naturl. Club.)

A small collection of reptiles and fishes from Lake Tanganyika examined by Dr. Gunther includes a new genus of snakes, Glypholycus, of which one species only is described, *G. bicolor*. Two new species of Mastacembelus which appear to connect the Asiatic species with the West African, and three species referred to Chromis. (Proceeds. London Zool. Soc., Nov., 1893.)

According to Dr. Shufeldt the fibula in many birds is complete, normally reaching the ankle-joint. He cites as examples in the Steganopodes, the Snake-bird *Plotus anhinga*, *Phalacrocorax bicristatus* (almost complete), *Sula piscator*, *S. cyanops*, *S. bassana*, *S. gossii* and *Fregata aquila*. Judging from the literature upon the subject, this fact concerning avian anatomy is not generally known. (The Ibis, July, 1894.)

Among the mammals of Baltistan and the Vale of Kashmir, presented to the U. S. Natl. Mus. by Dr. W. L. Abbott, are three species of Arvicola, *A. fertilis*, *A. montosa* and *A. albicanda*, which are new, and also a new geographical race of *Mus arianus*. *Sminthus concolor* in this collection extends the range of that species a thousand miles. (True in Proceeds. U. S. Natl. Mus. Vol. XVII, 1894.)

In his studies of North American Mammals Mr. F. W. True finds it necesssary to place Brewer's mole in a new genus, Parascalops. In the same paper are given diagnoses of an undescribed race of Albert's squirrel, *S. aberti concolor*, a new lemming, *Myodes nigripes*, and a lemming-like mouse, representing a new genus, *Mictomys innuitus*. (Proceeds. U. S. Natl. Mus., 1894.)

ENTOMOLOGY.[1]

North Ameridan Ceutophili.—This interesting group of wingless locustarians has been monngraphed in a very satisfactory manner by Mr. S. H. Scudder.[1] "With the exception of the genus Troglophilus Krauss, with two species from European caverns, and the genus Talitropis Bol., with a single species from New Zealand, placed respectively at one and the other end of the series, they are known only from America; and with the further exception of Heteromallus Brunner, with two species from Chili, they are all peculiar to the United States and Northern Mexico. Here they include six genera and sixty-seven species, the genus Ceutophilus alone containing above fifty species. The larger proportion of them, if not all (excepting *Udeopsylla nigra*) frequent dark places, such as burrows, pits, caverns, wells, hollow trees, and especially the crevices beneath fallen logs." Thirty-eight new species are characterized in the present paper, in which the treatment, except for the absence of illustrations, is all that could be desired.

The Plume Moths.—A study of the biological relations of the earlier stages of the plume months convinces J. W. Tutt[3] that these insects belong to two distinct families, the Pterophorina and the Alucitina. The latter (called Orneodinæ by Fernald and others) "belong to the Pyraloid section of the Obtectæ, the larva of which has a complete circle of hooks to the ventral prolegs, and the pupa of which is smooth and rounded, laterally solid, inner dissepiments flimsy. The free segments in both sexes are the fifth and sixth abdominal.

"The Pterophorina belong to the Incompletæ and have no affinities with Alucitina. Both groups have under the same or similar necessities developed plume wings and this is the only connection. The pupa is attached by a cremaster, less solid and rounded, appendages often partially free. Free segments may extend up to the third abdominal."

In emphasizing the necessity of biological studies in classification, Mr. Tutt quotes with approval, the recent dictum of W. H. Edwards: "There never will be a final authoritative revision of any genus of butterflies till the preparatory stages in every species of it are known."

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2]Proceedings Amer. Acad., VXXX, pp. 17–113.

[3]Ent. News, V, 209.

New Use for Bisulphide of Carbon.—Professor J. B Smith acting on the suggestion of Professor H. Garman finds by experiment that bisulphide of carbon can be used to advantage against aphides on plants above ground. By covering infested melon vines with a tub or other closed vessel, and allowing a drachm of bisulphide to evaporate in a shallow dish beneath it, the pests were killed at the end of one hour. The coverings were then removed.

Mimicry in Diptera.—Mr. C. J. Wainwright reports[4] interesting observations on mimicry of Diptera flying in England in early spring. Two species of the Syrphid genus Cheilosia so resembled bees of the genus Andrena as to make it very difficult to distinguish them. "They particularly resembled *Andrena fulva*, and we netted far more of the bee than of the Dipteron in our efforts to get the latter. The resemblance is very strong, color, size, and (to a considerable extent) shape being much the same; when at rest on a flower the Dipteron curls its body under a little as the bee does, and folds its wings over its back in the same manner."

There was also present a species of Echinomyia of the family Tachinidæ, which had a bee-like appearance, differing in this respect from other members of its genus. "It, however, resembled no species in particular; it bore a general resemblance to *Bombus muscorum* in size, shape and color, but it was not so hairy and did not fold its wings bee fashion."

In commenting on these observations Mr. Wainwright says: "There is very little doubt that in the spring, when insects are not very numerous, and when, therefore, we may reasonably infer that their enemies are unusually alert in discovering and capturing them, that it must be even more necessary than during the summer, for those insects which do appear, to be well protected in some way from their foes, and especially if they happen to be species which, through feeble reproductive powers or other similar causes, are limited in numbers to commence with. Now, the two Cheilosiae are distinctly species which are limited in numbers, in fact, they are somewhat rare species, and may be described as occurring singly; they are not robust species, in fact, rather the reverse, and, therefore, they are just such species one would expect to find protected by mimetic resemblances. In every way they may be said to present all requirements of an ordinary case of mimicry.

"The Echinomyia, however, does not present so ordinary a case. It is a wonderfully strong and robust species, belonging to a group of

[4]Ent. Monthly Magazine.

parasitic species, all of which are strong and robust, and ordinarily neither need nor possess any such protection as a mimetic resemblance. It is well protected on the body by strong hairs, answering, to some extent, the purpose of spines, and is very strong on the wing; it is very large, too, many specimens being 8 or 9 lines long. It, however, occurs at this time (March) when other insects are scarce, and it must be conspicuous and so tempt its foes, and although common on this particular occasion at Wyre Forest, I do not think it is usually a common species, at least, I never saw it before; altogether, although it does not answer the usual requirements of a mimetic species, yet there are obviously good reasons why a resemblance to the strong and usually unmolested Bombi would be an advantage to it. We accordingly find that it does possess some such resemblance, though imperfect, and it is just this imperfection which is its most interesting feature, and it is to some extent the reason for these notes.

"Many or all of the opponents of the theory of mimicry urge very strongly the difficult question, how does the resemblance arise? In early stages it can be of no use to its possessor. But here, I think, we have a case showing how mimicry may arise, and even the early stages be of use. The Tachinidæ do not, as a rule, resemble in the least degree any Hymenoptera, they are quite unlike bees. The Echinomyia are a genus of unusually large and well developed Tachinids, some of which (fera and ferax for example) are simply ordinary Tachinids in appearance, though unusually large, and quite unlike bees; they are summer species; Ursina, however, a spring species, though closely allied to these others by a comparatively slight alteration in color, a development rather than an alteration, and the increase of its hairs in number and size, at once and unexpectedly somewhat resembles *Bombus muscorum*, and almost certainly must derive some protection from even this superficial resemblance, at a time when food is being so eagerly sought by insect foes. It only needs a still further increase in hairiness, and to fold its wings over its body, and it would be an almost perfect mimic; and supposing its nearest allies to be lost, we should wonder how the early stages arose."

Description of a New Pelecinus from Tennessee.—The genus *Pelecinus* forms a peculiar family allied to the Proctotrupidæ, in the Antigynea, among the highest Aculeate hymenoptera. The costal vein in rare instances is not developed, showing a transition to the higher non-aculeate monotrocha or Hymenoptera minuta. The larval habits are unknown, although the imago has been observed issuing from the ground and locust eggs are possibly its food. The discovery of a new species is therefore of interest.

The antennæ are fourteen-jointed in both sexes, those of the male longer. The mandibles, armed with a tooth near the apex within, and the labial palpi show no sexual difference. The maxillary palpi, long in the female, are not visible in the male. The middle and the hind tibiæ are two-spurred in both sexes; the hind tibiæ greatly swollen in the female, are no more swollen than the femora in the male. The first joint of the hind tarsi in both sexes is as short as the last joint.

The abdomen of the female is elongate, cylindric, six-jointed, with a seventh dorsal joint connate with the sixth; sting minute; the abdomen of the male is cup-shaped, likewise six-jointed; claspers directed forwards beneath. In the male abdomen the first segment is three times as long as all the rest combined, gradually enlarged towards the extremity; the third and fourth segments are longer above than beneath; the fifth and sixth segments are vertical, invisible from above.

PELECINUS BRUNNEIPES, n. sp.

Female.—Size of *dichrous*. Disc of propodeum behind puncto-reticulate. An oblong brown cloud in the first submarginal cell behind the stigmal cloud. Legs piceous-brown; middle and fore tibiæ and tarsi clay-yellow. Tenth and apical half of ninth joints of atennæ whitish. The whole insect otherwise shiny black.—One specimen collected at Marysville by Prof. E. M. Aaron.

In *P. polycerator*, which is of larger size, the disc of propodeum behind is transversely arcuately rugose, the depressions punctate; there is no separate cloud in the wing; and the legs, except tarsi, are entirely black.

PELECINUS DICHROUS Klug.

Specimens of this South American species, kindly sent me by Prof. Carl Berg, of Buenos Ayres, show the disc of the propodeum behind transversely rugose in the female and longitudinally rugose in the male. The female has the ocellar tubercle, the clypeus, a spot above clypeus, a spot at base of mandibles, the thorax (especially above) red; the legs more or less brownish; the tenth joint and apex of ninth joint and base of eleventh joint of antennæ orange. The male has none of the red shown in the female and the atennæ are entirely black.

WM. HAMPTON PATTON.

Flight of Locusts.—Mr. C. B. Mitford gives an interesting account[5] of what was, he says, a more marvellous sight than any he has ever seen. The changed appearance of the "bush" at Freetown, Sierra Leone, on the 25th of November, 1893, led him to call the attention of a native, who told him that locusts were coming. In a short time huge black clouds appeared above the hills, and these first seen gave the idea that the whole of the sides of the hills, three miles off, were on fire; at 2.45 p. m. these supposed clouds reached Freetown and proved to be a continuous mass of locusts, which passed without intermission till 5.10 p. m. Myriads settled, but made no apparent difference in the size of the swarms. The whole town was covered with their excrement. At 9.45 a. m. the next day the stream began again, but not in such dense masses, and continued up to 1 p. m. The species has been found to be *Pachytylus migratoroides* originally described from Abyssinia.—*Journal Royal Microscopical Society.*

[5]Proc. Zool. Soc. Lond., 1894, p. 2.

PSYCHOLOGY.

The Habit of Amusement in the Lower Animals.—In some former papers which have already been published in this journal and elsewhere, I have shown that animals exceedingly low in the scale of animal life possess the five senses, sight, smell, taste, hearing, and touch, or senses akin to them; also that these animals evince a high degree of intelligence.[1] One would naturally expect to find in animals biologically so akin to man, some evidences of enjoyment other than the mere gratification of animal desires. This expectation or surmise is undoubtedly correct, and it is the purpose of this article to demonstrate this truth. We are all familiar with the pastimes of the higher animals such as the dog, the cat, the horse, the squirrel, the rabbit, the monkey, etc. We do not question the fact that these animals do amuse themselves in many a frolic and wild romp; they form a part and parcel of our lives, consequently their pastimes are not considered remarkable. I propose, however, to show that animals much lower in the scale of life—animals so low and so minute that it takes a very high-power lens to make them visible, likewise have their pastimes and amusements. Also, that many insects and even the slothful snail are not so busily engaged in the struggle for existence that they can not spare a few moments for play. In our researches in this field of animal intelligence we must not attribute the peculiar actions of the males in many species of animals when courting the females, to simple pastime, for they are the outward manifestations of sexual desire, and are not examples of psychical amusement. I have seen, in actinophorous rhizopods, certain actions, unconnected with sexual desire or the gratification of appetite, which lead me to believe that these minute microscopic organisms have their pastimes and moments of simple amusement. On several occasions while observing these creatures, I have seen them chasing one another around and around their minature sea. They seemed to be engaged in a game of tag. This actinophrys is not very agile, but when excited by its play, it seems to be an entirely different creature, so lively does it become. These actions were not

[1] North American Review: "The Senses in the Lower Animals."
American Naturalist: "Animal Intelligence."
Atlantic Monthly, Contrib. Club: "Animal Letisimulants."
Worthington's Magazine: "The Emotions in the Lower Animals."

those of strife, for first one and then another would act the pursuer and the pursued. There were, generally, four or five actinophryans in the game. One of the rotifers frequently acts as if engaged in play. On several occasions I have observed them perform a kind of dance, a *pas seul*, for each rotifer would be alone by itself. Their motions were up and down as if exercising with an invisible skipping-rope. They would keep up this play for several minutes and then resume feeding or quietly remain at rest. This rotifer goes through another performance which I also believe to be simply a pastime. Its tail is armed with a double hook or forceps. It attaches itself to a piece of alga or other substance by this forceps, and then moves its body up and down in the water for several minutes at a time. The snail (*H. pomatia*) likewise has its moments of relaxation and amusement. The following instance of play may be considered to be gallantry by some, but I do not believe that I am mistaken, however, when I consider it an example of animal pastime. Two snails approproached each other, and, when immediately opposite, began slowly to wave their heads from side to side. They then bowed slightly several times in courtly salutation. This performance they kept up for quite a while and then moved away in different directions. At no time did they come in contact, and careful observation failed to reveal any excitement in the genitalia. I have witnessed the embraces of snails, and the performance described above does not resemble in the slightest degree, the manouvres executed at such times by mating individuals.

Swarms of Diptera may be seen on any bright day dancing in the sunlight. Naturalists have heretofore considered this swarming to be a mating of the two sexes. This is not the case, however, in many instances. On numerous occasions, and at different seasons of the year, I have captured dozens of these insects in my net and have examined them microscopically. I found them all to be unimpregnated females; I have never yet discovered a male among them. In some of the Diptera the males emerge from the pupa state after the females; I therefore believe that the females await the presence of the males, and, while waiting, pass the time away in aerial gambols.

Forel, Lubbock, Kirby, Spence and other naturalists have declared that ants, on certain occasions, indulge in pastimes and amusements. Huber says that he saw a colony of *pratensis*, one fine day, " assembled on the surface of their nest, and behaving in a way that he could only explain as simulating festival sports or other games." On the 27th of last September, the males and females of a colony of *Lasius flavus* emerged from their nest; I saw these young kings and queens congregate about the entrances of the nest and engage in playful antics until driven away by the workers. The workers would nip their legs with their mandibles until they were forced to fly in order to escape being bitten. On the 19th of this month (July) I saw several *Lasius niger* come out of their nest accompanied by a minute little beetle (*Claviger foveolatus*); the ants caressed and played with this little insect for some time, and then conducted it back into the nest. Many little animals are kept by ants simply as pets. Lubbock says of one of them, a species allied to *Podura*, and for which he proposes the name, *Beckia*. "It is an active, bustling little being, and I have kept hundreds, I may say thousands, in my nests. They run in and out among the ants, keeping their antennæ in a perpetual state of vibration." I have frequently noticed an insect belonging to the same species as the above, in the nests of *F. fusca* and *rufescens*. They reminded me very much of the important-looking little dogs one sees running about in the midst of a crowd on market-day. In the November issue of the Naturalist, I describe a spider which indulges in a peculiar pastime. This spider spins a web where the rays of the early morning sun strike. Through the long diameter of the web, she spins a narrow ribbon, and, as soon as the sun shines upon it, she goes out on this ribbon and promenades up and down. She never takes food caught in this web; her hunting- or trap-web is generally several feet away, but connected with her pleasure resort by a bridge.

Sometime ago I witnessed a bit of malicious sport, in which, the participants were fleas. I was observing a *Pulex* sleeping beneath the short hairs of a dog's axilla. My lens was a good one and I could clearly make out the body and limbs of the little sleeper. Suddenly there appeared another flea, which stopped short as soon as she discovered her sleeping comrade. She remained quiet for several seconds and then nimbly bounded on the others back. Clasping her body with her hind legs, she began vigorously "to touzle the hair" of her surprised sister. She then sprang away into the thicker hair, closely pursued by the thoroughly aroused and evidently angry victim of her sport.

The females of the coleopterous *Coccinellæ* frequently congregate and indulge in performances that can not be anything else save pastimes. A beech tree in my yard is called "ladybug tree" because, year after year, these insects collect there and hold their curious conventions. They caress one another with their antennæ, and gently shoulder one another from side to side. Sometimes several will get their heads together and seem by their actions to be holding a confidential conversation. These conventions always take place after oviposition, and careful and repeated observation has shown me that they are not connected with procreation or alimentation. I have witnessed many other instances of true psychical amusement in the lower animals but do not think it necessary to detail them here. Suffice it to say, that I believe that every living creature, at some period of its existence, has its moments of relaxation from the cares of life when it enjoys the gratification of true psychical amusement.—JAS. WEIR, JUN., M. D.

ARCHEOLOGY AND ETHNOLOGY.[1]

Dr. Brinton on the Beginning of Man.[2]—Dr. Brinton contributes a characteristically readable and inconsistent article to the *Forum* on this subject, which is the most important and interesting among the many presented by the science of biology. It is also at the same time a prime question among archeologists, but as the archeological materials do not lend themselves to its solution, the cultivators of that science have not generally devoted much time to its investigation. Archeology begins, as Dr. Brinton says, with the evidence of human industry; that is, it begins after man had become man, and not before. It, therefore, commences where paleontologic biology leaves off, and does not embrace the question of his ancestry, which belongs to the latter science. Nevertheless, Dr. Brinton, well known as a distinguished archeologist, discusses the question of the ape-ancestry of man in an entertaining, and to some extent, instructive manner. But I have some fault to find with his article from a biological standpoint, and as it is calculated to encourage some popular prejudices, I propose to state them.

First there is to be noticed throughout, the flavor of Virchoffism, which has been so vigorously exploited by Haeckel. Virchow appears to be unalterably opposed to the hypothesis of the ape-ancestry of man, and he uses frequent opportunities of casting ridicule on it. He even goes so far as to ignore, when convenient to his argument, such evidence as there is in support of it, in a way which does not impress me with his capacity for fairness. His conspicuous fallacy is his neglect of the biological evidence for the doctrine of creation of organic species by descent, so far as regards man. This is so overwhelming, that biologists are a unit in believing in it. Man cannot be excluded, for his zoological affinities with the anthropoid apes are most pronounced. Man is not an example of an isolated type, of which many can be found among animals and plants, but his relatives are conspicuously close to him in structure, so that if evolution is true, man is one of the most evident illustrations of it. Yet Brinton says "a dozen years ago when Darwinism was at its height, an advanced scientific thinker would have felt compelled to maintain that the species man was necessarily a de-

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

[2] The Beginning of Man and the Age of the Race by Dr. D. G. Brinton; *The Forum*, Dec., 1893, p. 452.

velopment of some lower mammal." I do not hesitate to say that Darwinism (i. e. evolution) was never at a greater "height" than it is at present. It is also highly uncomplimentary to the "scientific thinker" to charge him with holding views on account of the "height" of any opinion, rather than on the evidence.

The type of man of the paleolithic age, is stated by Brinton to be a fiction which "furnished imaginative writers with the compound creature they pictured in their books as our common ancestor," etc. He then proceeds to discredit this "compound" by showing that some mistakes were made by some investigators in some points, although when he says that that the Neanderthal remains belong to a visibly diseased subject, he asserts more than has been proven. He also alleges that the depressed forehead and prominent superciliary ridges of various paleolithic skulls that have been discovered, are no indication of pithecoid origin, since they can be found occasionally among men of existing races! An argument of no value whatever, since if all low types necessarily disappeared, man would be the only animal; no monkeys ought to exist; no insects, no Amoebas! Evolution does not attempt to prove that nothing has stood still! But our author has nothing to say about the jaws of Naulette and Shipka, and the man and woman of Spy. It is on just these important remains that Virchow is silent also!

But he does have something to say on the tritubercular superior molar[3] and the lemuroid affinities of the Anthopomorpha (man and ape). Referring to the author of the present review, he says: "An eminent naturalist discovered that in a considerable number of people the tubercles on the teeth resemble those of lemurs more closely than those of monkeys. Hence he promptly drew the concluslon that the descent of man was directly from the lemurs and not from the monkeys, as the prevailing impression has been." Dr. Brinton has advanced in his views a little. He at one time declared that this statement as to the structure of the molar teeth in the higher as compared with the lower races and the apes had been "refuted" by Allen and Virchow. Soon after this, my statements were entirely confirmed by Topinard, who after a full examination of six hundred dentitions de-

[3] The reviewer of my paper in the April, '93 Naturalist on The Genealogy of Man, says of the tritubercular molar, that it is only the long known "microdontie" of civilized races. (Archiv. für Anthropologie, 1893). The reviewer evidently does not know what the tritubercular molar is nor what it signifies. It is not necessarily microdont, nor is it confined to civilized man. He has evidently not read my paper on the subject or he would not have remarked that I give no figures as to its predominant occurrence in the Esquimaux. (See Am. Journ. Morphology, July, 1888).

clared that man from having had four tubercles above and five below, would in some distant future have three above and four below. But he added that the theory of descent from lemurs is " not sustained " or " is premature." This latter question is one for paleontological biologists to decide, and Prof. Topinard did not even discuss the evidence from this standpoint. There is, however, good reason to suppose that the anthopoids (not man only) did descend from lemuroids and not from monkeys. Since Dr. Brinton's article was written, Dr. Forsyth Major has described an extinct *plistocene* lemur from Madagascar nearly as large as a chimpanzee, with tritubercular superior molars. I look for future discoveries to demonstrate the truth of the lemurine descent of the Anthropoids, and that the monkeys (Ceropithecidae) are a side branch and not in the direct line.

The descent of man from the Anthopoids is antagonized by Virchow because some of the pithecoid characters of man are not prenatal, but only appear in later growth stages and cannot therefore be inherited. And if he can find a mechanical cause for the character, so much the more certain is this conclusion in his opinion. An example of this is the ape-character found among various men ancient and modern, the platycnemic or compressed tibia. This Virchow alleges is not a mark of affinity to the apes, where it is universal, but that it is produced by a peculiar use of the muscles of the lower leg, especially of the anterior ones. This, however, only transfers the evidence from the bones to the muscles. The tibial form of the apes, it may be inferred, is produced in the same way as in man, and if it is so produced in men, we learn that in such cases the muscles and their use are like those of the apes. Prof. Virchow does not probably know, that if inheritance be believed, the entire osseous skeleton of the vertebrata has been moulded by the strains, pressures and impacts to which it has been subjected, and that these are directly or indirectly due to muscular contraction. The supposition that prognathism is not inherited from apes because it is not present in the foetus, is equally untenable. The change of shape of the relations of the cranial bones called prognathison, is common to all vertebrata, and is only delayed, more in apes, most in man.

But Dr Brinton, like many other objectors to evidence of a plain and unadorned character, has his *Deus ex machina.* " Genius is ever inexplicable " he says. True; but the shapes of bones and teeth are not, and the brains of the genius contain the structural reasons for their functions, although we have not yet seen them. " A family of, we know not which of the higher mammals, perhaps, the great tree ape, which then lived in the warm regions of central France, may have produced a few 'sports,' widely differing physically and mentally from the parents, and these 'sports' were the ancestors of man." Here we have a theory submitted to biologists, which is not supposed to be Darwinism or apeism, and yet it bears a strong family resemblance to both. To my vision, it appears inconsistent with some of what has gone before. Its special mission appears to be, to get rid of the "missing link." But he cannot be gotten rid of so easily. "This is a theory" Brinton says "which is as good as another." But it is not as good as another, until all the ape characters of man, recent and paleolithic, are explained away. In fact I suspect that the "sporting" is altogether confined to the theory! for paleontology does not give any ground for supposing that sports have any part in the general advance which we call evolution. The process has been by the gradual accumulation of increment after increment. Besides, the "tree ape" turns out to have been a baboon!

E. D. COPE.

SCIENTIFIC NEWS.

The Danish government has decided upon a deep-sea exploration of the waters of Greenland and Iceland. The work will be carried on during 1895 and 1896. A botanist will accompany the expedition.

The American Museum of Natural History has organized an expedition, under the direction of Professor Rudolph Weber, to make collections and a scientific exploration of the Island of Sumatra.

An expedition has been organized in Australia for a scientific exploration of the mountains of Macdonnell near the centre of the continent. The party will be equipped and directed by Mr. W. Astin Horn, a wealthy colonist. The scientific corps is strong and numbers among its members Mr. Winnecke, geographer; Mr. E. C. Strisling, naturalist; Professors R. Tate and Baldwin Spencer, paleontologists; Mr. J. A. Watt, mineralogist.

The American Association for the Advancement of Science has again subscribed $100 for a table at the Marine Biological Laboratory at Woods Holl. Last year it did the same, but, we learn, some of those who should have been consulted concerning its disposition were left in absolute ignorance of any award. This year the table has certain conditions attached, which it is hoped will settle the question of responsibility. These conditions are:

1. That the table shall be known as the American Association for the Advancement of Science table.

2. That the table shall be awarded by a committee of five, consisting of the vice-president and secretary-elect of each of the two sections (F and G), and the director of the Marine Biological Laboratory (at present, Dr. C. O. Whitman).

3. That any member or fellow of the Association may apply for the table (an applicant for membership to the Association will be considered as a member and is therefore eligible).

4. Applications for the table are to be made to the permanent secretary of the Association (F. W. Putnam, Cambridge, Mass.), who will forward them to the chairman of the committee of award, the chairman being the senior vice-president of sections F and G, seniority being determined by continuous membership.

5. Holders of the Association's table will be expected to give due credit in published results of investigations carried on at the Association's table.

The death of the venerable D. C. Danielssen of Bergen, Norway, on July 13th, removes one of the ablest of the Scandanavian systematists. Most of his zoological work was done on the marine Invertebrates and was of an exceedingly careful character. He was besides a physician in regular practice, was the chief of the Leprosy Hospital at Bergen, and since 1864 has been the president of the Bergen Museum. He was born in 1815.

Gustave Honoré Cotteau, the well known paleontologist is dead, aged seventy-six. His principal work was done in the Echinodermata, of which subject he was the leading student in France.

Two of the American Arctic exploring expeditions have come to grief. The vessel of the Chicago newspaper enterprise under Wellman was crushed in the ice and some of the party returned to the Spitzbergen islands, while the leader with others was picked up and landed at Tromsoe, Norway. The Cook expedition which consisted mostly of scientific men, went in an iron vessel in oppostion to the advice of experienced arctic navigators. In her first contact with the ice a hole thirty feet long was torn in her side. She subsequently ran on a rock near to Sukkertappen and subsequently sank. The passengers were brought to Labrador by a passing vessel, but lost all their property.

The Salt Lake Literary and Scientific Association, a body incorporated for scientific pursuits, with headquarters at Salt Lake City, Utah, has recently endowed a chair of Geology in the University of Utah. The endowment is made in the handsome sum of $60,000, the proceeds of which are to be used in the support of the professorship. The chair has been named the "Deseret Professorship of Geology," and Dr. James E. Talmage has been appointed to the position. The rich collections of the Deseret Museum, belonging to the Salt Lake Literary and Scientific Association, have been placed at the disposal of the growing University of Utah. Such a movement is commendable. Utah is a rich field for the geologist, and any substantial encouragement of the science there is an effort wisely directed.

Dr. Chas. L. Edwards, lately of the University of Texas has been elected Professor of Biology in the University of Cincinnati, Cincinnati, Ohio.

☞As the year 1894 is now drawing to a close we would respectfully ask the many delinquents **to send in their subscriptions,** that we may close our books for the year with a clean bill.


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THE MECHANICAL CAUSE OF FOLDS IN THE APERTURE OF THE SHELL OF GASTEROPODA.[1]

BY WM. H. DALL.

The folds which are frequently present on the columella and the lip of the aperture of the shells of Gasteropoda, may, I think, be traced to a mechanical cause. In considering the dynamic relations of the animal to its shell we may obtain satisfaction on this point. In the fusiform rachiglossa an anatomical difference exists to which I believe attention has not hitherto been called. Indeed, unless the principles of dynamic evolution are granted it is a difference which would appear to have little or no significance. These principles, however, afford a key which seems to unlock this and many other mysteries. In the plicate forms of this sort the adductor muscle, which in all gastropods is attached to the columella at a certain distance within the aperture, is attached *deeper within the shell* than in non-plicate forms. The point of attachment may be an entire turn, or even more, behind the aperture, while in short globose few-whorled shells and in the non-plicate forms it is, as a general rule, little more than half a turn within the aperture.

[1]Adapted from the Transactions of the Wagner Free Institute of Science, Philadelphia, Vol. III, 1890, p. 58.

Now let us consider the dynamics of the case. We have, reduced to its ultimate terms, a twisted shelly, hollow cone, sub-angulate or even channelled at two extremes corresponding to the canal and the posterior commissure of the body and outer lip. Inside of this we have a thin, loose epithelial cone, the mantle, of which the external surface especially toward the margin, is shell-secreting; lastly, inside of the mantle-cone we have a more or less solid third cone, consisting of the foot and other external parts of the body of the animal, which can be extended beyond the mantle-cone outwardly, as the mantle-cone can be beyond the shell-cone. The body-cone and the mantle-cone are attached at one of the angles of the shell-cone some distance within the opening of the spiral of the latter. The two outer cones constitute a loose, flexible funnel within a rigid, inflexible funnel, while the body-cone forms a solid, elastic stopper inside of all.

What will happen according to mechanical principles (which can be tested by any body with the simplest apparatus) when the mantle-cone is withdrawn into a part of the shell-cone too small for the natural diameter of the contracted mantle-cone? It must wrinkle longitudinally. Where will the wrinkles come? They will come at the angles of the shell-cone first; they will be most numerous toward the aperture, since toward the aperture the mantle-cone enlarges disproportionately to the caliber of the shell, owing to its processes, the natural fold of the canal, etc., etc.; the deepest and strongest wrinkles will be over the pillar, owing to the fact that the attachment of the adductor prevents perfect freedom in wrinkling, and the groove of the canal will mechanically induce the first fold in that vicinity. The most numerous small wrinkles will be near the aperture opposite the pillar, because of the mantle-edge this is the most expanded part, and there will be a tendency to a ridge near the angle of the posterior commissure. Repeated dragging of a shell-secreting surface, thus wrinkled, over a surface fitted to receive such secretion, will result in the elevated shelly ridges which on the pillar we call plications, and on the outer lip liræ, if long, or teeth if short. The commonly existing subsutural internal ridge on the body of the shell near the posterior commissure will mark the special conditions in that part of the aperture.

When the secreting surface is thus wrinkled or corrugated longitudinally the wrinkles and the concave folds between them will be directed in the sense or direction in which the body moves in emerging from or withdrawing to the whorl. The summits of the convex wrinkles will be appressed more or less forcibly against the shell-wall exterior to them in which they are contained. The semi-fluid, living secretion of which the shell-lining is built up, exuding from the whole surface of the mantle, will be rubbed away from the lines of the summits of the wrinkles and tend to accumulate in lines corresponding to the concave furrows between the wrinkles. This secretion hardens rapidly, and these lines would become somewhat elevated ridges which would by their presence (when once initiated) tend to maintain the furrows and wrinkles in the same place with relation to the thus-initiated liræ, as these elevated lines are called when on the outer lip; or plaits, when situated on the pillar.

The modification referred to generally takes place during resting stages of the animals' growth, since while the animal is rapidly extending its coil the secretions seem to be concentrated along the mantle margin, while the general mantle-surface resumes its secretive function (or the latter becomes active) somewhat later, after the formation of a definite shelly varix, or thickened margin, indicating a resting stage in the animal's career. It is probable also that during rapid growth there is less compression of the tissues than during the resting stages. The external sculpture and some of the modifications of the aperture are connected with the functions of the extreme edge of the mantle; those we are at present considering relate more especially to the function of its general surface by which the layer which lines the whorls, the pillar, plaits and liræ are solely secreted and deposited.

In species with the adductor muscle attached to the pillar near the aperture the wrinkles would be fewer, and their action, if any, confined to the vicinity of the margin of the aperture. The deeper the attachment the greater will be the compression of the secreting surface and the distance over which it is constantly dragged back and forth, and the consequent length of the ridges of shelly matter deposited. If the inner or mantle-cone had the whole cavity to itself, it is evident that it could and would infold itself in a manner which might not appress its folds against the inner surface of the rigid outer or shell-cone. But there the mass of the solid and elastic foot and external body comes into play, and by its withdrawal inward forces the wrinkled mantle-cone against the shell. The mantle is thus confined between a rigid outer and

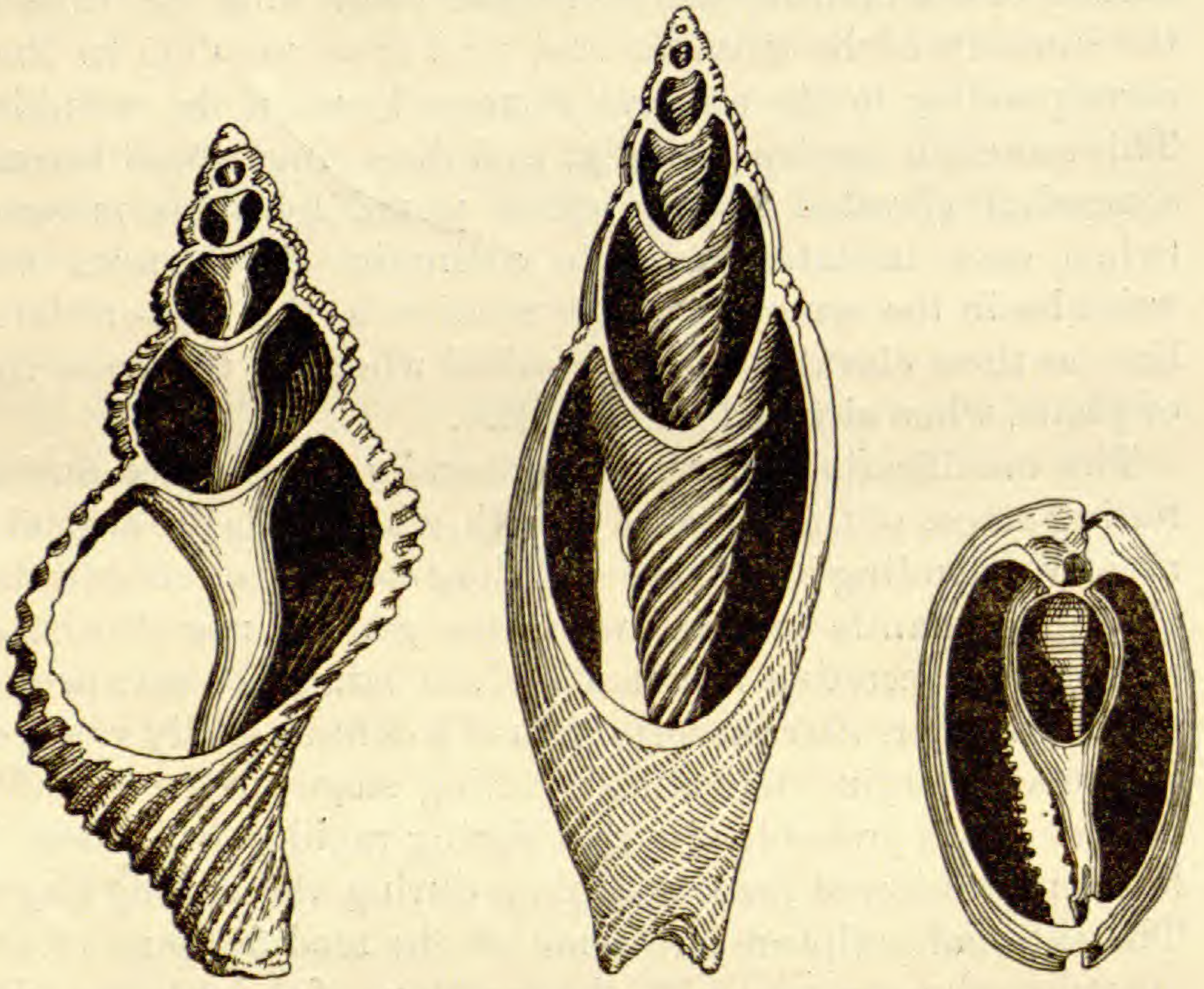

Fig. 1. Fig 2. Fig. 3.

Fig. 1. *Fusus parilis* Conr. a gastropod in which the caliber of the spire contracts uniformly within the aperture but which, having a short retractor muscle develops no plications on the axis.

Fig. 2. *Mitra lineolata* Heilprin, a gastropod otherwise similar, but in which the retractor is long and deep seated and in which the axis becomes plicated.

Fig. 3. *Siphocypræa problematica* Heilprin, a gastropod in which the aperture is contracted and the cavity within ample so that plications are developed on the sides of the aperture but not on the axis within.

an elastic inner surface, with the result that it cannot recoil from the former and that a certain uniformity of size and direction is imposed upon the wrinkles, except where the recess of the canal allows them to become more emphatic, or to a less degree, the posterior angle permits a slight expansion. The mechanical principles involved may be readily illustrated by the experiment of pulling a handkerchief through the neck of a bottle, or funnel, followed by a cork in the center. Of course, the more nearly the apparatus conforms to the form and twist of a spiral shell the more nearly the results will approximate to those of nature. It is difficult, however, to find any artificial tissue which will correspond in elasticity, or capacity for partial self-contraction, to the living tissues concerned in nature. Hence an exact conformity is not to be expected though the mechanical principles may be reasonably well illustrated.

A comparison of specimens will show that the results exhibited agree with marvellous precision with the results called for by the preceeding hypothesis, based on the dynamical status of the bodies concerned, their motions and secretions. The agreement is so complete as to amount to a demonstration, though in certain cases there may be complications which need additional explanation.

A point which may be noted in regard to the Volutidæ, to which my attention was called by Mr. Pilsbry, is that in this group the mantle is greatly extended and there would be more of it to be wrinkled than in such forms as Buccinum, etc. It may be added that the forms in which we note the beginning of plaits for this family, many of them, such as Liopeplum and Volutomorpha, had the mantle so extended as to deposit a coat of enamel over the whole shell, as in the modern Cypræa, so that here we have an additional reason why plication should be emphasized in this group.

Of course, as before noted, the mechanical principles are the same in any group of gastropods, but among those in which the wrinkling is confined to the region of the aperture or those shells which are lirate or dentate as opposed to plicate, several other principles come into play which may be briefly referred to in passing. In the first place, those species which have a very extended mantle, with hardly an exception have a lirate aperture (*Oliva, Olivella, Cypræa, Trivia*, etc.). With species in which there is a widely extended mantle and yet no lirations, it will usually be found that the mantle is not entirely withdrawn into the shell in such forms, or is permanently external to the shell (many *Opisthobranchiata, Marseniidæ, Sigaretus, Harpa*, etc.). In a group, like the *Cypræidæ*, where nearly all the species are lirate on both lips, there are a few which want these liræ, and these are species which have a wider aperture in the adult than most of the genus, and in which we should expect the wrinkles to be less emphatic.

SOME BIRDS OF PARADISE FROM NEW GUINEA.

BY GEO. S. MEAD.

Of that class of the feathered creation to which the term Birds of Paradise has been applied, and which they certainly most appropriately bear, New Guinea with its adjacent islands is the home, or at least the greater number of the dozen or more species of this unrivalled family belong to these regions. Mr. Wallace, a recognized authority on these birds, as well as on the Malay Archipelago, seems to limit their range to the northern side of the mainland. Other travellers, however, have found them on the southern side, as well as in other parts of New Guinea. The Italian naturalist, D'Albertis, for example, encountered several species, notably *Paradisea raggiana*, along the Fly River—a large stream flowing southeast from the mountains of the interior and emptying into the Gulf of Papua, to the right of Torres Straits.[1]

Yet the northern side, as Mr. Wallace points out, certainly presents as safe a retreat as could be found for these lovely and much prized treasures of the feathered world. Impenetrable swamps, the rugged coast, impassable mountain ranges, fierce tribes of natives, illimitable forests—all these and other barriers are so many means of protection which it is to be hoped will long preserve a wild life that possesses the fatal gift of beauty, against utter extermination.

There is nothing perhaps but physical difficulties or the subsidence of a fashion that can save birds of paradise from the destruction which a barbarous propensity, and the careless

[1] "On the south coast of N. G. the vegetation is generally of the most luxuriant character, even for the tropics. One vast dark jungle spreads over its muddy shores, abounding in immense forest trees, whose trunks are hidden by groves of sago palms, and myriads of other heat and moisture-loving plants. Unlike the eastern and southern coasts of N. G., the northwestern part is described as being generally covered with timber, but having no underwood or dense jungle, so that it is very easy travelling under the shade of the lofty trees. The country is said to abound with small fresh-water streams, and patches of good grass." Polynesia, p. 175.

cruelty of women seem to make inevitable. Nature herself, therefore, must shield her own from the complacent notion that everything living is subservient to the whim or caprice of civilization or to the savage who ignorantly ministers to it.

These favored regions, besides those of the Aru Islands, where birds of paradise also abound, are rich in vegetation beyond even the usual fecundity of the tropics. Almost as unique, varied and lovely, are other forms of animal life—butterflies, dragon-flies, lizards, insects great and small, and countless tribes of the feathered race.

In the eyes of lovers of the gorgeous, among birds the king bird of paradise, *Cicinnurus regius*, is without a rival. It is indeed of surpassing loveliness, if, as some one says, an adjective so distinctive can properly be applied to any species when all are so lovely. The bird itself is of small size, nor does the plumage stand forth to that extent it reaches in other species, but within this compass the most perfect, soft and dazzling effects of delicate tints are displayed. While the plumage of all the birds of paradise is singularly beautiful, still more beautiful and magical is the play of shifting lights. The least movement on the part of the bird, the slightest displacement of a feather, the turning of a leaf or the letting in of a sunbeam, produces a wondrous and entrancing change. After death the colors pale, in many instances almost immediately, and of course the evanescent hues lose their startling brilliancy. Over the prevailing tint of red on the king bird, "a gloss as of spun glass wavers." The head is of deep orange, the throat cinnabar, the breast snow-white; between the breast and throat is a dividing belt of rich green. Like silk with its sheen and softness is the white breast; white also is seen over each eye. On either side of the lead-colored legs, at times hidden under the wings, tufted, white-tipped feathers, puffed out like the down on the soft powder-brushes ladies use, are to be noted, for they form a curious adjunct to the dress of the male bird. From the tail-feathers a pair of wire-feathers, five or six inches long, project; these are separated at their ends by an equal distance, and are webbed outwardly so as to form two circlets about the size of a coat-button. Capt. Moresby, in his interesting book, "Discoveries in New Guinea," gives so admirable a description of the king-bird of paradise as to deserve quotation here:

"This bird," he says, "is as large as a small thrush, the back glossy crimson, the head feathers being soft, and deep in tone like velvet, the throat crimson, and separated from the pure white breast by the wide band of green. It has the long wire tail of all birds of paradise, terminating, however, in two circular feathers, about the size of a sixpenny piece, of a burnished green. But its peerless ornaments are two small feather fans of intense emerald color, set in the upper joint of the wing, and capable of being spread or folded at pleasure."

Not unlike the best known of all the birds of paradise, *P. apoda*, is the red-bird, *Paradisea sanguinea*. It cannot, however, be considered as the peer in beauty, its resemblance consisting chiefly in the fall of long plumes from the back, giving that appearance, so characteristic and so attractive, as of a cataract of feathers falling in a maze of wavy lines and spray. Where these soft plumes are golden in *Apoda* the red-bird has a deep crimson. Yellow prevails on the head and neck, extending a short distance on the back. A yellow band passes across the breast, flanked by green and brown. All these tints blend into each other, the line of division never being closely marked excepting on the throat. A corrugated arrangement of short velvety feathers gives a singular appearance to the head; this and the long filaments reaching beyond the loose wing plumage serve in making it one of the most striking ornaments of the bird creation.

The size of *Sanguinea* or *Rubra* is about that of a robin, perhaps a little larger, and its favorite resort the recesses of Waigiou Islands.

Paradisea apoda, the great paradise bird, has become a familiar object of admiration in museums of natural history and collections. In no other bird is the coloring so rich and the blending of browns, purple, green and orange so alluringly beautiful. Add to this the long, curving fall of plumes behind, and one of the most entrancing spectacles animate nature has to show is vouchsafed.

This is the species early brought to Europe by travellers, and even made an object of commerce. No wonder that, deprived of its sturdy, somewhat ugly legs and feet, people fabled the lovely creature to be not of earth but aerial, never settling on gross, material things, nor living on terrestrial food, but passing its halcyon existence above mundane growths, or like matchless Belinda's lock, wafted to the skies:

> "A sudden star, it shot through liquid air,
> And drew behind a radiant trail of hair."

Which last line, it has always seemed to me, fairly well describes the appearance of a shafted bird of paradise while in flight.

In his travels along the Fly River, N. G., in 1872–5, D'Albertis found (what he considered new to science) *Paradisea raggiana*, so named by Mr. Sclater, after Marquis Raggi, of Genoa. This beautiful bird of paradise the Italian explorer described by its differences from *P. apoda* and *P. minor* rather than by any special marks of its own. It is less in size than the great-bird, but in luxuriance of plumage almost its equal. In opulence of colors, too, it vies with the loveliest. A golden belt widening above divides the green throat from the ruby breast; a splash of the same color appears on the wings, while the back is untinged. Red prevails on the side wings running along the floating plumes. It is very probable that *P. apoda* and *P. raggiana* interbreed; possibly other varieties. D'Albertis notes several evident instances of hybrids, and names the characteristic markings of those specified—the yellowish tinge at the back of the throat, the small wing feathers banded with gold, etc. The velvety softness of the feathers is as observable in *Raggiana* as in all birds of paradise, while the exquisite intermingling or suffusion of vivid colors, although at the same time these are quite distinct, is just as inimitable. Long, curving wire-shafts adorn this species also.

Of less flaming colors than the last mentioned species, although the transition of hues is even still more wonderful, and lacking the flowing train of plumes and caudal appendages of other members of its kind, the *Lophorhina superba* or *atra* hardly falls behind its congeners in beauty and attractiveness. Instead of the radiant splendor of the *Apoda* or *Raggiana*, the colors of *Superba* are darker but marvellously rich, —purple, violet, green, bronze, blue—ever varying and shifting in changing lights, the whole shot over with satin sheen, while silken gleams run fitfully along the compact feathers which, nevertheless, never lose their velvety softness. While to compensate for waving plumes, we have a gorgeous green bifurcated shield for the breast and two pseudo wings or wing coverings raised or depressed at will. The head glistens as with scales of dark green or blue, according to the reflections. It is not without the singular crests or protuberances which distinguish certain birds of this family, and it is not unlikely that the feathers are at times also erected when the bird is excited or pleased.

The unique adornment, however, of *Superba*, not omitting the curious extensions of metallic green athwart the breast, is the half-united pair of mock wings spreading out when raised, from the shoulders above the head and shadowing the back and sides. The color is black, but blazing with lustre, so that as the light strikes the tips of the feathers they become bronze or blue, or even green, almost iridescent, always resplendent. In size, shape and indescribable coloring, this mantle forms one of the most remarkable combinations of feathers which even a bird of paradise can show, this, too, on a little creature not more than nine inches in entire length.

D'Albertis informs us that the natives of New Guinea call the bird *niedda*, "from the sound of its notes." If this is so, its voice is materially different from the discordant cry of other *Paradisea*.

We hear from the incomparable emerald bird of paradise (*Apoda*), for instance, only a hoarse "wok, wok," or a succession of cawing, unmusical sounds.

In the Golden bird of paradise, *Paradisea sexetacea* or *Parotia sefilata*, we find another example of dark, rich clothing in contradistinction to the gay apparel of other species of the race. The somewhat misleading appellation, golden, is derived from the flashing colors of the gorget or escutcheon below the throat. The rest of the bird is invested in more neutral tones—black, purple, bronze and green—lighting up into metallic brightness or deepening into dark, funereal velvet with every movement.

As the superb-bird is glorious with great shoulder-crests waving like a duplicated fan, and a two-fold breast shield, so the Golden has its own peculiar mark of uniqueness in the six long threadlike shafts projecting, three on either side, from the head, and terminating in an oval web. These wire feathers are movable and can be thrust at pleasure straight out or thrown back upon the body. The head is still further ornamented with the usual erectile feathers brushed back, as it were, from the beak; some gray in coloring or white shine like jewels or precious stones. On the sides, soft, massive pectoral plumes, jet black, pass beyond and over the wings, covering them when lowered and almost concealing the rounded tail as well.

EXPLANATION OF PLATES.

PLATE XXIX. From Brehm's Thierreich.

Fig. 1. *Paradisea apoda.*
Fig. 2. *Parotia sefilata.*
Fig. 3. *Cicinnurus regius.*

PLATE XXX. From Brehm's Thierreich.

Seleucides alba.

PLATE XXXI.

Paradisea raggiana Scl. from the Natural History of New Guinea.

THE PSYCHOLOGY OF HYPNOTISM.

BY JAS. WEIR, JR., M. D.

The various phenomena accompanying animal magnetism, so-called, have been observed and commented on by man since a very early era in his history. Our savage ancestors, whose psychical development had just begun, considered these manifestations to be a direct evidence of the supernatural, and those individuals who, either actively or passively, gave evidences of this, to them, occult power, to be directly influenced by supernatural agencies. This manner of regarding these phenomena has, in a measure, descended to us, and the vast majority of civilized beings of to-day look with a certain awe on the person who is laboring under hypnotic influence. The sceptical minority, however, generally regard hypnotism as a baseless fraud and imposture. Both classes of individuals are in error; the first, because there is nothing supernatural in the phenomena of so-called animal magnetism; the second because these phenomena really do exist and are the result of perfectly natural causes. The term, animal magnetism, owes its origin to a tradition which came into existence about the middle of the sixteenth century. At that time, man conceived the idea that he could influence his fellows in a manner analogous to that of a magnet, attracting some, and repelling others. The first written evidence of this belief occurs in the works of Paracelsus. He maintained that "the human body was endowed with a double magnetism, that one portion attracted to itself the planets, and was nourished by them, whence came wisdom, thought and the senses; that the other portion attracted to itself the elements and disintegrated them, whence came flesh and blood; that the attractive and hidden virtue of man resembles that of amber and the magnet; that by this virtue, the magnetic virtue of healthy persons attracts the enfeebled magnetism of those who are sick." The latter part of this doctrine is believed by many people at the present time; witness the widespread belief that an enfeebled person should not occupy the same bed with a strong, lusty individual, lest the enfeebled vitality of the one should be overcome and absorbed by the stronger vitality of the other. Many scientists of the sixteenth and seventeenth centuries, notably Glocenius, Fludd, Kircher, Burgrave, and Maxwell accepted the doctrines of Paracelsus, and declared that all natural phenomena could be explained through magnetism. These learned gentlemen thought that by magnetizing talismans and hanging them about the persons of the sick, that the vital spirit could be infused thence into the bodies of invalids, thus effecting cures.

Anthony Mesmer, who was born in Germany in 1734, discarded the talismans and magical boxes of his predecessors and applied this, so-called, universal principle directly to the bodies of the sick through the agency of passes and contact. In the beginning of his career, however, Mesmer used the magnetic steel tractors of the Jesuit, Father Hell. He soon abandoned them and confined himself to manual manipulations and passes, asserting that animal magnetism was entirely distinct from the influence exerted by the magnet.

In 1779 Mesmer left Vienna and came to Paris, where he at once began to give lectures on his theory of the magnetic fluid. In these lectures he declared that "he had discovered a principle capable of curing all diseases." Says Binet and Feré: "He summed up his theory in twenty-seven propositions, or rather assertions, most of which only reproduce the cloudy conceptions of magnetic medicine." These propositions while they are full of the mysticisms, the errors, and the superstitutions naturally belonging to the period at which they were formulated, yet contain the germs of scientific truths. As I wish to establish, later on in this paper, the fact that certain individuals are more susceptible to hypnotic influence than are others, I will here introduce evidence obtained from the writings of one who witnessed Mesmer's *seances.* Says Bailly: . . . "They are so submissive to the magnetizer that even when they appear to be in a stupor, his voice, a glance, or sign will rouse them from it. It is impossible not to admit, from all these results, that some great force acts upon and masters the patients, and that this force appears to reside in the magnetizer. It has been observed that *many women* and *few men* are subject to such crises." These crises were characterized by "*convulsions, cries, shouts, and groans.*" The same writer says elsewhere: "It has been likewise observed that they (crises) are only established after the lapse of two or three hours, and that when one is established others soon and *successively* begin." (Certain words and expressions are here and elsewhere italicized for future reference). Mesmer's treatment became exceedingly popular. He, consequently, incurred the jealousy and hatred of the Academy of Science and the Academy of Medicine, these academies emphatically declaring that there was nothing in his method and that his theory was arrant nonsense. Where upon Mesmer left France, notwithstanding the fact that the government offered him a life-pension of 20,000 francs on the sole condition of his remaining and continuing his method of practice. He returned, however, at the solicitation of his admirers who offered him a purse of 10,000 louis for a series of lectures on magnetism. These lectures were published and set the kingdom into a ferment, many declaring that Mesmer was a charlatan and a fraud, while as many more declared that he was a great discoverer and a benefactor of the human race. In 1784 the government ordered an investigation and appointed a commission to inquire into magnetism. Their report is exceeding interesting, in as much as it shows how very near, indeed, these men of wisdom were, in grasping the salient features of hypnotism. Benjamin Franklin was a member of this commission, his name being signed first of all. A translation of report reads as follows: "The commissioners have ascertained that the animal magnetic fluid is not perceptible by any of the senses; that it has no action, either on themselves or the patients subjected to it. They are convinced that pressure and contact effect changes which are rarely favorable to the animal system, and which injuriously affect the imagination. Finally, they have demonstrated, by decisive experiments, that imagination apart from magnetism produces convulsions, and that *magnetism without imagination produces nothing.* They have come to the unanimous conclusion with respect to the existence and utility of magnetism, that there is nothing to prove the existence of the animal magnetic fluid; that this fluid, since it is non-extistent, has no beneficial effect; that the *violent effects* observed in patients under public treatment are due to contact, to the excitement of the imagination, and to *mechanical imitation* which involuntarily impels us to repeat that which strikes our senses. At the same time, they are compelled add, since it is an important observation, that the contact and repeated excitement of the imagination which produce the crises may become hurtful; that the spectacle of these crises is likewise dangerous, *on account of the imitation faculty* which is a law of Nature; and consequently that all treatment in public in which magnetism is employed must in the end be productive of evil results.

(Signed) B. FRANKLIN, MAJAULT.
BAILLY, LEROY, D'ARCET.
DEBORY, GUILLOTIN.
LAVOISIER.

Shortly after this report was presented, the Royal Society of Medicine filed their report in which they came to the same conclusions, one member, however, Laurent de Jussieu, dissenting. De Jussieu filed a separate report in which he foreshadowed several points now universally acknowledged to be established truths. He declared that the experiments demonstrated the fact that man was capable of producing a sensible impression on his fellows through the agency of friction or, contact. Charcot has shown that "the efficacy of contact and friction is proved by the existence in certain subjects of hypnogenic zones, of which the slightest stimulation produces somnambulism; that the irritation of hysteriogenic zones produces convulsions, and that these zones are generally seated in the hypochondriac, or in the ovarian regions, on which Mesmer preferred to exercise his manipulations." M. de Puységur of Buzancy, near Soissons gave, in 1784, the first account of hypnotism produced by manipulation, and the sequent phenomena of healing by suggestion. He discovered

PLATE XXIX.

1. *Paradisea apoda.* 2. *Parotia sefilata.* 3. *Cicinnurus regius.* From Brehm's Thierleben.

that a patient, whom he was treating for inflammation of the lungs, was thrown into a condition resembling sleep, yet, who retained conciousness, spoke aloud, and attended to his every day affairs. De Puységur discovered that, by suggestion, he could change the current of this patient's thoughts and make him do his bidding, at one moment, weeping as if it in great sorrow, the next, laughing as if convulsed with joy. "In his *waking state* he was *simple* and *foolish*, but during the *crisis* his intelligence was *remarkable*." From 1784 to 1882 the science of hypnotism and the treatment by suggestion was undergoing a slow evolution which finally culminated in the work of M. Charcot, who at last took this beneficial therapeutic agent from the hands of charlatans and quacks, and placed it where it belongs—among the remedial agents of reputable, scientific physicians. I have shown in this brief *resumé* of the history of hypnotism that certain classes of individuals were more susceptible to this influence than others, and that gender was a great and favorable factor. The words previously italicized show that women more frequently than men were influenced by hypnotic suggestion, and that these favorable subjects always gave evidences of hysteria or kindred neurotic lesions. The observations of Charcot and his pupils substantiate the experiences of the older scientists in this respect, and my own experience tallies with that of Charcot. I, therefore, deem it safe to advance the proposition, that the individuals who yield to the influence of hypnotism are always those who are neuropathic; Prof. Charcot wrote me, a short while before his death, that "he had come to the conclusion that all hypnotic subjects were the victims of neurotic lesion in some form or other." When we come to study the psychological phenomena accompanying hypnotism, we at once discover that this is a perfectly natural and absolutely truthful conclusion.

Man possesses two kinds of conciousness—an active, vigilant, co-ordinating conciousness, and a passive, pseudo-dormant, and, to a certain extent, incoherent and non-co-ordinating conciousness. We can readily prove the truth of this by observing certain phenomena which are to be noticed daily among ourselves. A man falls into a "brown study," and, if gently approached without being startled, he may be asked questions which he will answer intelligently without any concious act on his part. His subconciousness, for the time being, holds him beneath its sway. Yet his active conciousness is not so much obtunded but that he can answer questions intelligently. Again, if a musician seated at a piano and improvising, be approached and gently questioned, he will answer the questions intelligently without ever ceasing his improvisation. His subconciousness is elaborating the sweetest harmonies, yet his active conciousness is not so far away but that it can give utterance to co-ordinating thought action.

Again, when the active conciousness is stilled in slumber, subconciousness sometimes remains awake and makes itself evident in dreams. The lack of rational thought—co-ordination in subconciousness is shown by the more or less extravagance and incoherence of dreams. Everything, no matter how unnatural and extravagant, occurring to the dreamer, is accepted by him as being natural and consistent. When, however, his active conciousness is aroused, he at once recognizes the incocoherence of his dreams. I hold, emphatically, that all dreams, when closely studied, will show extravagance and incoherence. A dream may seem, at first glance, to be entirely coherent, but, if the remembrance of the dream be perfect and it be closely studied, numerous incoherences will always be discovered.

We know how easy it is for us to lose ourselves in abstraction. We will sit for several moments seemingly in profound thought, yet when suddenly aroused and asked what engaged our thoughts, we are unable to tell. We have been in a subconcious state, probably revelling in the wildest vagaries. Fortunately for us, degeneration has left no weakened spot in our active conciousness on which to engraft the erotic imaginings of our non-coordinating subconciousness, consequently our moments of subconciousness are blanks. The favorable hypnotic subject is easily thrown into the subconcious state. The sudden entrance of a bright light into a darkened room; a loud noise; a sudden stillness after prolonged noise; the crackling of a lighted match; a breath of cold or warm air is all that necessary, sometimes, to bring about hypnosis. I regard hypnosis as a state analogous to that of the "brown study" in which active conciousness is obtunded or asleep. It is, however, an intensified and aggravated form of mental abstraction, in which active conciousness is, more or less, profoundly affected. Why is it, that in the case of the favorable subject of hypnotism, the active conciousness can be so easily overcome? Simple because it is weakened by neurotic degeneration. That portion of the psychic system in which dwells active conciousness is always the first to degenerate and lose its tonicity. This is shown by the thousands of erotic mental habitudes and perversions that are to be noticed in neuropathic and psychopathic individuals. Active conciousness—the balance-wheel of the psychic system, becomes disordered and at once a flood of erotic fancies make themselves evident. It stands to reason that, in an individual, who shows by his actions and his thoughts that he is the victim of nervous degeneration, his active conciousness would be easily obtunded and put to sleep. This is, emphatically, the case, a fact that is clearly demonstrated by the favorable hynotic subject, who is always neuropathic. We know that subconciousness is capable of receiving an impression and of acting entirely independent of active conciousness—witness the phenomena of somnambulism.

When this fact is admitted the phenomena of hypnotic suggestion are readily accounted for and understood. We have seen that many subjects fall into the hypnotic state when excited by the most trivial extraneous influences such as the scratching of a match; a sudden noise; or a sudden stillness coming after long and continuous noise. Again, hypnosis can be produced by the favorable subject, sometimes, without the aid of extraneous influences. A patient of mine, an hysterical woman, would seat herself in a chair, "look cross-eyed," and, in a very few moments, become hypnotized. On one occasion, in order to test her condition, I commanded her to repeat the following lines, in lieu of the usual blessing, the next morning at breakfast: "*Juro tibi sanctæ per mystica sacra Dianæ me tibi venturam comitem sponsamque futuram.*" I wrote these lines on a slip of paper and gave it to her husband, a good Latin scholar, who declared that she repeated them word for word, giving the correct pronounciation, adding, however, the word "amen." This lady had never studied Latin and was not familiar with the quotation. Another patient, a young girl, who was psychopathic and neurothenic, could hypnotize herself by gazing at the brass ring of a window curtain. Both she and I discovered this fact accidently, I, having discovered her, on one occasion, in a hypnotized state, intently gazing at the brass ring just mentioned. By a systematic course of fasting and mental abstraction, thus weaking active conciousness, the *tchogis* and *fakeers* of India are enabled to throw themselves into a hypnotic condition at will. I have seen so-called spirit-mediums and clairvoyantes who could bring about hypnosis a dozen times daily if necessary. Surely no one will assert that these subjects are influenced by magnetism emanating from themselves or from outside objects. One might just as well accept the doctrines of Paracelsus and his disciples of the sixteenth and seventeenth centuries. We have seen that the usual avenues to the hypnotic state lie through the senses of sight and hearing, yet the sense of touch affords another avenue. On the bodies of favorable subjects there are certain areas called hypnogenic zones. When these zones are rubbed or tickled the subject immediately passes into the hypnotic state. In conclusion let me state, that I am confident that hypnosis can be produced in the favorable subject, through many different avenues or agencies, and that every one of these agencies will be absolutely devoid of magnetism or any occult force.

RULES OF NOMENCLATURE ADOPTED BY THE INTERNATIONAL ZOOLOGICAL CONGRESS, HELD IN MOSCOW, RUSSIA, 1892.

PART II.

TRANSLATED BY MORITZ FISCHER.[1]

I. NOMENCLATURE OF HYBRIDS.

1. (*a*) In the naming of hybrids the name of the male should preceed that of the female, and be united with the latter by the sign of multiplication. The use of the astronomical signs to indicate sex can be dispensed with. Of the two examples following, either can be used, as *Capra hircus* ♂ × *Ovis aries* ♀, or *Capra hircus* × *Ovis aries.*

(*b*) Another method can be employed for this purpose. The two names can be represented as is a fraction, the name of the male forming the numerator, and that of the female the denominator, as $\frac{\text{Capra hircus}}{\text{Ovis aries.}}$. This second method possesses the advantage that the name of the observer can be indicated whenever such indication is desirable, as $\frac{\text{Bernicla canadensis}}{\text{Anser cygnoides}}$ Rabé.

(*c*) The second method should be employed where either one of the parents is a hybrid, as $\frac{\text{Tetrao tetrix} + \text{Tetrao urogallus}}{\text{Gallus gallinaceus}}$.

(*d*) In case the parents of a hybrid are unknown, it provisionally takes a simple specific name like a true species, but the generic name is preceded by the multiplication sign, as ×*Salix erdingeri* Kerner.

II. GENERIC NAMES.

2. Every foreign word employed, either as a generic or specific name, should retain the meaning it has in the language from which it is taken, if in this language it denotes an organized being, as *Batrachus bdetta.*

III. SPECIFIC NAMES.

3. The geographical names of uncivilized countries, and of such peoples as do not use the Latin alphabet, should be tran-

[1] The first part of these rules was published in the AMERICAN NATURALIST for May, 1892.

From the *Revue Scientifique,* No. 15, tome 50.

scribed according to the rules adopted by the *Geographical Society of Paris.*

4. Both the preceeding article and article 21 of the rules adopted by the Zoological Congress of Paris, in 1889, are applicable to names of persons, as *Boydanovi, Metcknikovi.*

5. The virginal spelling and all diacritic signs must be preserved in the Roumanian and certain other Slavonic languages (Polish, Croatien, Bohemian), and likewise in those which use the Latin alphabet, as *Tænia Mediči, Congeria Cžjžžki.*

6. Specific names may be formed from feminine patronymics or from common nouns. In such cases the genitive takes the ending *oe* or *orum* to the full name of the person to whom one dedicates, as *Merianoe, Pfeifferoe.*

IV. Spelling of Generic and Specific Names.

7. (*a*) Patronymics or surnames used for specific names must always be spelled with a capital letter, as *Rhizostoma Cuvieri, Francolinus Lucani, Laophonte Mohammed.*

(*b*) A capital letter can be used with certain geographical names, as *Antillarum, Galliae.*

(*c*) In all other cases, the specific name is spelled with a small letter, as *Oestrus bovis, Corvus corax, Inula helenium.*

8. If the name of the subgenus is cited, it should be placed in parenthesis between the generic and specific names, as *Hirudo* (*Haemopis*) *sanguisuga.*

9. If the name of a subspecies or variety is cited, it follows the specific name without any inter-punctuation. The name of the author of this subspecies or variety can be cited likewise without inter-punctuation, as *Rana esculenta marmorata* Hallowell.

10. If a species has been placed in a genus other than the one to which it was assigned by its author, the name of this author is retained in notation, but placed in parenthesis, as *Pontobdella muricata* (Linné).

V. Subdivision and Consolidation of Genera and Species.

11. If a species is subdivided, the limited species to which is applied the name of the original species receives a notation

indicating both the name of the author who established the same and the name of the author who subdivided the species as *Taenia pectinata* Goeze partim Riehm.

According to article 8, the name of the first author is put in parenthesis if the species has been placed in a different genus, as *Moinezia pectinata* (Goetze partim) Riehm.

VI. Family Names.

12. A family name must be discarded and replaced by another if the generic name from which it was formed is a synonym, and is itself discarded.

VII. Law of Priority.

13. Zoological nomenclature dates from the issue of the sixth edition of *Systema naturae*, published in 1758. This is the standard work to which that zoologist must refer who wishes to investigate and employ the oldest generic and specific names, provided they conform to the fundamental rules of nomenclature.

14. The law of priority is applicable to family names or to those of higher groups, as well as to the names of genera and species, provided groups are concerned which have a similar extension.

15. A species which has been wrongly identified, must take its correct name, according to article 35 of the rules adopted by the Zoological Congress of 1889.

16. The law of priority must obtain, and consequently the oldest name must be retained.

(*a*) When some part of a creature has been named before the creature itself was known, as in the case of fossils.

(*b*) When the larva, supposed to be an adult form, has been named before the adult form was known.

Exception should be made for the Cestodes, the Trematodes, the Nematodes, the Acanthocephales, the Acariens and, in fine, for all animals passing through metamorphic and migratory stages. Many of these species are now being revised, and their nomenclature will possibly undergo a complete change.

(*c*) When the two sexes of the same species have been considered as distinct species or as belonging to different genera.

(*d*) When the animal presents a regular succession of unlike generations, which have been considered as belonging to divers species or even genera.

17. It is very desirable that each new description of a genus or species be accompanied by a diagnosis in Latin, or, at least, a diagnosis in one of the four best known European languages, i. e., French, English, German, Italian.

18. In works not published in one of the above-mentioned languages, the explanation of the plates should be translated entire, either into Latin or one of the continental languages.

19. When several names have been proposed simultaneously, and priority for any one cannot be established, there should be adopted—

(*a*) That name which is applied to a well-characterized and typical species, in case of a generic name.

(*b*) That name which is accompanied by either figure, diagnosis or description of an adult form, in case of a specific name.

20. Generic names already employed in the same kingdom cannot be used.

21. The use of those names should be avoided which can only be distinguished by their gender endings or by a simple orthographic change.

22. Specific names already employed in the name genus cannot be used.

23. The generic and specific names which become non-available through the application of the foregoing rules cannot be employed anew, even if they express a new meaning in the same kingdom, if the name is generic; in the same genus if the name is specific.

24. A generic or specific name once published cannot be withdrawn, even by its author, on account of ambiguity.

25. All barbarisms and solecisms must be corrected; hybrid names, however, such as *Geovula*, *Vermipsylla* should be retained.

VIII. Allied Questions.

26. The metric system is the only one employed in zoology. Foot and span, pound and ounce should be banished forever from scientific language.

27. Heights and depths, speed and all other common measures are expressed in metres. Fathoms, knots, nautical miles and like terms should disappear from scientific language.

28. The one-thousandth part of a millemeter (Omm, 001), represented by the Greek letter μ, is the unit of measure adopted in micrography.

29. Temperatures are expressed in degrees of the centigrade thermometer of Celsius.

30. The indication of the enlargement or the reduction of an illustration is indispensable to its correct understanding. This indication is expressed in numbers and not by noting the number of the objective which was employed in producing the illustration.

31. It is proper to indicate whether a linear or a surface enlargement has been employed. These notations can easily be abridged, as : $\times$ 50 $\square$, indicating a surface enlargement of fifty times ; $\times$ 50 — indicating a linear enlargement of fifty times.

PRAIRIE CHICKEN AND WILD PIGEON IN JACKSON COUNTY, MICHIGAN, 1894.

BY L. WHITNEY WATKINS.

It has been nearly twenty years since the last prairie chicken, *Tympanuchus americanus*, was seen in this or neighboring localities. Occasionally reports have come to me of their presence still, in the vicinity of Freedom Swamps Washtenaw County, and Portage and Wolf Lakes Jackson County. Careful investigation, however, has found these reports founded, usually, upon the exaggeration of some hunter, possessed of an enthusiastic turn of mind, and entirely lacking in substantial evidence.

In 1893 we have the following notes on this species from neighboring counties: "Extinct at Ann Arbor, Washtenaw County," Dr. J. B. Steere. "Extinct for more than thirty years in Monroe County," Jerome Trombley. Authorities have generally regarded them as a game bird figuring only in the romantic past of this part of Michigan.

On April 22, 1894, Charles V. Hay, a clever sportsman of a town near at hand, brought me the welcome news that on the day previous he had actually flushed sixteen "chickens" in Merrill's cranberry marsh of about thirty acres extent and not a mile from the village of Norvell. As Mr. Hay has hunted these birds on the western plains there could be little doubt of the identity, and sure enough they were easily found, in all their old-time glory, a few days later. Local hunters were much excited as the news spread, and old followers of the "sport with rod and gun" shook their gray heads in silent amazement. They would as soon have expected to again witness the running ascent of the wild turkey among the broad-topped trees of the "Oak Openings," as the plunging rise of the prairie hen from the adjoining meadow. These birds are now nesting and once again the loud "booming" of the cocks has resounded back and forth among the hills which have not known the old familiar sound for many a year before.

Adolphe B. Covert, the veteran ornithologist and taxidermist of Washtenaw County, tells me that a small band of prairie chickens has continued to live in a tract of marsh land some distance from Ann Arbor, notwithstanding Dr. Steere's notes to the contrary. Thus it is very probable that our immigrants, unless they switched off from some western contigent of Coxey's Army, came from some such isolated locality where yet a few pairs nest, rather than in a long flight from the southwest as many would believe.

On June 13, 1894, late in the afternoon, as I was returning from an interesting day among the late-nesting water birds, a fine male wild pigeon, *Ectopistes migratorius*, was startled from a plowed field, lately sown to buckwheat, and rose in full view not more than thirty feet away, affording identification of which I am positive. He flew a few rods and dropped gracefully into the dense foliage of a maple tree by the roadside. Then as I approached, wondering at the presence of the beautiful bird, now so rare, whose garnished plumage turned the rays of the sun into a thousand bright reflections, and in a land over which, in numbers eclipsing all other species, his ancestry once fairly swarmed, he again took wing and with a rapid, measured tread of his pointed pinions disappeared in an instant over the wooded hills beyond. But the old-time flights of pigeons are forever of the past. It had been nine years since the last few were seen here, and we had begun to think it very probable that they would never again be noted.

On June 16, a pair were seen in the same field and on June 18 three were noted by my brother, two of which he was very certain were young of the year. Perhaps a pair of "$2.00 eggs" were hatched in this very locality.

Of the disappearance of the wild pigeon in Southern Michigan, we have the following notes: "Extinct at Ann Arbor in 1875," Dr. J. B. Steere. "Extinct in Monroe County in 1885," Jerome Trombley. "Last seen at Morrice, Mich., in 1881," Dr. W. C. Brownell.

We thus see that birds long supposed to be of the past may yet linger with us in a few lonely specimens. Oh! that we might reinstate again the proud hosts of the mystic past in the lands they once adorned, and in whose ornithological features they once figured so prominently. To this land a few still cling in loving faithfulness to the traits of an innumerable ancestry.

EDITORIALS.

We have frequently complained in these columns of the exclusive conduct of scientific enterprises by persons not acquainted with the sciences and not engaged in their pursuit. We will not enumerate the blunders committed by such persons under such circumstances, as they have recently come under our observation; but only refer now to a question of taste in which some of these well meaning persons have immortalized themselves in stone. A new building for the use of the collections of the Academy of Natural Sciences of Philadelphia was recently erected, chiefly from money appropriated by the Legislature of Pennsylvania. An entrance doorway was devised, and in order that it should represent the uses of the building, it was adorned with figures and reliefs of animals. Persons possessed of the least spark of originality would have seen the propriety of representing in these figures something appropriate to the country, and if possible the institution. Nothing would have been easier than to have placed at the entrance of the Museum, figures of some of the forms of life discovered by its members. The idea was suggested to the gentlemen in charge of the construction, but to commemorate in so conspicuous a manner the services of the naturalists of the Academy it did not strike them favorably. So it came that the apex of the entrance was surmounted by, not even an African lion, but an official British lion, with his mane brushed into a collar like Punch's dog, such as one sees on Government buildings in Great Britain. On each side is a lioness similar to those seen on buildings all over the world. At the summit of one lateral column is a head of a hound, and on the other side a ram with very unsymmetrical horns, both foreign importations. Of the animals in relief above the door, the only American animal is a crab, *Lupa diacantha*, which is indeed, very appropriate to the building commission, as it generally goes backwards, and pinches its nearest neighbors.

—When the natural sciences are taught in our public schools, there will be fewer absurd and untrue stories published in the newspapers. Thus a recent Philadelphia paper tells of a man in Arizona who had two Helodermas ("Gila monsters"), each three feet in length, which acted as watch-dogs for him, and which killed a would-be assassin who entered his house at night. From New York comes a story of a physician who fed his guests with cholera bacilli, and thus caused their deaths. This doctor is said to reside in Buenos Ayres, and his name is given. A New York paper publishes a reporter's interview with the Governor of Illinois, in which that worthy is made to say that he is afflicted with locomotor ataxia. According to the Governor, the interview never took place. Here inaccuracy has passed into mendacity, as in the case of the *New York World's* interview with the astronomer Secci, which were shown to have been pure inventions. One of the editors of this journal thought he would investigate the source of stories as to the frequent appearance of an alleged ghost on a moor south of Brooklyn last August. These stories had been published in a conspicuous way in several papers of New York and Brooklyn for several weeks, and it seemed worth while to look into a matter which they published as serious news. Nothing was seen, however, but a few young men, among whom were reporters of the *Brooklyn Eagle*, the *New York Sun*, and the *New York World*. The last-named confessed to having himself filled the rôle of ghost on one night by using newspapers, so that this ghost, like most others, appears to have been of a purely subjective origin on the part of one newspaper at least.

—LIEUTENANT PEARY'S party has returned, leaving him to prosecute his researches with only two companions. The results to geography are not great, as he was compelled to abandon the expedition to the northeast coast of Greenland, owing to extreme severity of the weather. Some of the men who have returned, have been talking in a way which shows that they are not adapted for service on an exploring expedition, and Lieutenant Peary is, apparently, well rid of them. It is hoped that the next season will be more propitious. We express here our regret that the Academy of Natural Sciences of this city has not contiuued to interest itself officially in this important enterprise, as it did in the beginning.

—AN artificial taste or custom has often interfered with healthy natural processes in human affairs. The follies of human fashions are innumerable. We refer now to one of minor importance, and yet one which well illustrates the proposition—that is, the alleged fattening of oysters for the market: The nearer the habitat of an oyster approaches salt water, the better will its flavor be, as, for example, the Blue Points of Long Island Sound, the Chincoteagues of the Maryland Coast, the Norfolks of Virginia and the Baratarias of Louisiana. These oysters all have, in the natural state, a brownish or yellowish tint, which, to the connoisseur, is a sure indication of their superior merits. Here, however, the perversity of an artificial taste enters. Many people must have them white. Such persons prefer a comparatively fresh water oyster, as the Maurice River Coves of the Delaware and those of the upper Chesapeake. Also, if they are not fat they must be made so. To accomplish these two most undesirable ends, the oysters are supplied with fresh water so gradually as not to kill them immediately. They lose the russet tint of health if they have it, and become swelled up by endosmosis. Their flavor is destroyed and is replaced by one that strongly reminds one of that of the leucomaines produced in the stomach by indigestion. The oysters are thoroughly sickened, and in this state are sold and eaten in large numbers by multitudes who do not know the flavor of that most excellent mollusc, a healthy salt water *Ostrea virginica.*

—THIS year was very wet during the spring in the Eastern States, and this period was followed by one of the severest draughts known in our history, which is now, fortunately, broken. The heat of the summer was nearly or quite equal to that of 1876. Whether these peculiar conditions be the cause or not, the scarcity in the same region of batrachians, reptiles and birds during the past season has been exceptional.

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RECENT LITERATURE.

Amphioxus and the Ancestry of the Vertebrates.[1]—This important monograph will be welcomed by all students of zoology as as a valuable accession to the literature of the theory of descent. More than this, the volume bears internal evidence throughout of painstaking care in bringing together, in an exceedingly readable form, all the essential details of the structure and metamorphosis of amphioxus as worked out by anatomists and embryologists since the time of Pallas, its discoverer. The interesting history of the changes it undergoes during metamorphosis, especially its singular asymmetry, is clearly described and ingenious explanations of the phenomena are suggested.

Most important, perhaps, are the carefully suggested homologies of the organs of *Amphioxus* with those of the embryos of the vertebrates above it in rank, especially those of the Marsipobranchs and Selachians. Though the comparisons with the organisms next below amphioxus, such as the Ascidians, *Balanoglosus, Cephalodiscus, Rhabdopleura* and the Echinoderms, will be found no less interesting. In short, the book may be commended to students already somewhat familiar with zoological facts and principles, as an important one to read. They may thus be brought to appreciate to what an extent the theory of descent is indebted to the patient labors of the zoologists of the last forty years for a secure foundation in observed facts, seen in their proper correlations, according to the comparative method.

The figures are good and there is very little that can be adversely criticised in the book. On page 176 it is stated that the ectoderm is not ciliated in any craniate vertebrate. To this statement exception must be taken in regard to the ectoderm of the sides of the body and especially the tail of young tadpoles just hatched. Born in his experiments, in grafting pieces of young tadpoles upon one another, found that the tail, when cut off and lying on its side, had a power of movement, in the cephalad direction, that could be explained only on the supposition that the ectoderm of the sides was more or less extensively covered with cilia. This observation the writer has confirmed in repeating Born's experiments in just hatched tadpoles of *Rana*. The

[1] Volume II of the Columbia University Biological Series, by Arthur Willey, B. Sc. 8vo, pp. 316, 135 figures. New York, MacMillan & Co., 1894.

volume, however, brings together everything essential that has ever been made out in regard to *Amphioxus*, so that zoologists will everywhere feel grateful to Mr. Willey for placing in their hands this very useful summary of its life history. The work contains not a little that is new, and some new figures not hitherto published. A very complete bibliography and index completes the volume. One hundred and thirty-three titles are comprised in the list of papers and works consulted in the preparation of the volume. If the other volumes in course of preparation by the professors in biology of Columbia University are up to the high standard of the present one, that institution is to be congratulated upon the enterprise of those who have initiated the project.—R.

Correlation Papers of the U. S. Geol. Survey: Archean and Algonkian.[2]—This memoir, written by Prof. C. R. Van Hise, is the seventh of the Correlation Papers series, and is, perhaps, one of the most important of that valuable set. The pre-Cambrian rocks of the United States and Canada, for convenience, are considered under the heads of seven districts, which are severally discussed in as many chapters. Each chapter is prefaced with abstracts of all the articles pertaining to the subject considered, classified by dates, together with summaries of the conclusions which appear to be established. Chapter VIII summarizes the various successions proposed, suggests one, and discusses the principles of pre-Cambrian stratigraphy. The Archean is the basal complex of America. It has everywhere, if large areas are considered, an essential likeness. It consists mainly of granitic, gneissic and schistic rocks, among which are never found beds of indubitable clastics. When different kinds of rocks are associated, their structural relations are intricate, which, together with the crystalline schistose character of the rocks, the broken and distorted mineral constituents, and involuted foldings are evidences that these rocks have passed through repeated powerful dynamic movements.

In regard to Algonkian stratigraphy, the writer accepts the structural and lithological principles enunciated by Irving, Pumpelly and Dale. It remains to be demonstrated, however, to the satisfaction of most geologists that the formation termed Algonkian, is not a part of the Cambrian.

[2] Bulletin of the Geological Survey, No. 86. Correlation Papers. Archean and Algonkian. By Charles R. Van Hise. Washington, 1892.

Economic Geology of the United States.[3]—In a volume of 509 pages, Mr. R. S. Tarr has compiled the information, up to 1893, concerning the mineral resources and industries of the United States. Although intended as a text-book to supplement a course of lectures at Cornell University, the style of the writer makes it of general interest. Part I treats of the common rock and vein-forming minerals and ores, the rocks of the earth's crust, physical geography and geology of the United States, origin of ore deposits, and mining terms and methods. Part II takes up metalliferous deposits in detail. The statistics are almost all compiled from the standard sources. An appendix contains the literature of the subject and a list of authors and works referred to in the text. A number of cuts illustrate the text.

Woods' Invertebrate Paleontology.[4]—This crown octavo of 222 pages, by Professor Henry Woods, is the first of the Cambridge Natural Science Manuals. In it the author presents a condensed account of the invertebrate paleontology necessary for a geological student, limiting himself for space reasons to a consideration of those fossil animals that are most useful to a stratigraphist. Each group is discussed according to the following general plan: first, its general geological features; secondly, the classification, characters and time range of the geologically important genera; thirdly, the distribution of each group. The text is abundantly illustrated and well indexed.

[3] Economic Geology of the United States with briefer mention of Foreign Mineral Products. By R. S. Tarr. New York, 1894. MacMillan & Co., Publishers.

[4] Elementary Paleontology for Geological Students. By Henry Woods, B. A., F. G. S. Cambridge, 1893.

General Notes.

PETROGRAPHY.[1]

Zirkel's Petrographie.—The second volume of Zirkel's treatise on Petrography[2] has recently appeared in America. It treats with such fulness of the massive rocks that an epitome of its contents is out of the question in this place. The volume discusses the composition, mineral and chemical, the structure and the distribution of the various types of the eruptive rocks with a thoroughness found only in German text-books. The descriptions of their important occurrences will be especially valuable to the student who has not a library at his disposal; and to the investigator, the large and accurate lists of references scattered through the book are very welcome. Many petrographers will differ with the author as to the importance and desirability of some of his types, and others will find fault with him concerning some of his theories, as, for instance, that of the origin of olivine aggregates in basalts. The volume is, however, on the whole quite free from theoretical discussions. While it loses something of its interest in consequence of this lack of theory, the book gains the confidence of the reader, who desires more particularly an account of the work done in the different provinces, where the rocks in which he is interested are to be found.

Inclusions in Volcanic Rocks.—Two articles on the petrographical changes affected by the partial or entire solution of foreign inclusions in volcanic rocks have recently appeared. The first is an essay by Dannenberg,[3] and the second a volume of 710 pages by Lacroix.[4] Dannenberg's article treats more particularly of the inclusions in the Siebengebirge basalts, andesites and trachytes. Zircons, corundum, magnetite, pyrite, feldspar, sillimanite, quartz, sandstone, schists and granite were found included in both basic and acid rocks of the region. Those inclusions that were most similar to the including rocks suffered much less alteration than those that differed most in chemical composition from the lavas. The aluminous compounds frequently yielded

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]F. Zirkel: Lehrbuch der Petrographie, Leipzig, 1894, pp. iv and 941.

[3]Min. u. Petrog. Mitth. XIV, p. 17.

[4]Les Enclaves des Roches Volcaniques, Macon, 1893, pp. 710, pl. vii, fig. 84.

spinels as a consequence of the contact action. In many instances different combinations of inclusion and including rocks gave rise to the same new products, so that it is difficult to discover the exact law governing the changes. In the basalts the principal inclusions consisted of single minerals, while in the more acid rocks they comprised largely rock fragments—a fact probably attributable to the different solvent powers of the including material. Lacroix's volume is a nearly complete treatise on the subject of which it treats, which is limited, as the title indicates, to the study of inclusions in volcanic (effusive) rocks only. The author separates inclusions into two classes. The first comprises fragments of an entirely different nature from that of the enclosing rock, as granite in basalt. These he calls enallogenous (enclaves énallogènes). The second class comprehends inclusions more or less similar in composition to the including material. These he terms homogeneous inclusions (enclaves homoeogènes). The second class embraces aggregates formed by segregation and by liquation, as well as true inclusions. The including rocks are also separated into two groups, the basaltic and the trachytic. In the first part of the book the enallogenous inclusions are discussed with great thoroughness. In the second part the homogenous inclusions are studied. In a third part are collected the general conclusions. Chapters are devoted to each class of rocks and divisions of the chapters to the character of the inclusions in them. Resumés and paragraphs embracing the results of the studies are scattered through the volume at convenient intervals, and a geographical index concludes the book. The number of discoveries made by the author in the course of his work is too large for discussion in this place. The book bears evidence of thoroughness throughout. It is an excellent contribution to the subject of contact action.

The Basic Rocks of the Adirondacks and of the Lake Champlain Region.—Kemp[5] gives a brief account of the coarse basic rocks of the Adirondacks of which the well known norite is a phase Associated with the norite are anorthosites, gabbros and olivine gabbros, all of which are more or less schistose. The anorthosites are crushed, and where the shattering has been most intense their plagioclase has been changed to a fine grained aggregate, thought to be saussurite. Augite and brown hornblende are present in these rocks, but not in large quantity. Garnets are always present. The more basic gabbros are dark rocks, whose plagioclase has a greenish tinge due to the abund-

[5]Bull. Geol. Soc. Amer. 5, p. 213.

ance of dust inclusions scattered through it. The special features of the gabbros are the reaction rims around pyroxene and magnetite. A zone of small brown hornblendes is often found between the first named mineral and plagioclase. Between magnetite and feldspar are usually three zones, of brown hornblende, pink garnet, and quartz, respectively, the last named mineral occurring nearest the feldspar. Sometimes the order of the zones is different. The quartz may appear within the zone of garnets, in which case the latter mineral may replace the feldspar in part, as alternate lamellae between lamellae of plagioclase. The gabbros contain large bodies of titaniferous magnetite. On the contact of the eruptive with limestone the latter rock has been crystallized and silicified. The same author, associated with Marsters,[6] has described the trap dykes of the Lake Champlain region as camptonites, fourchites, monchiquites and bostonites.

The Augite Granite of Kekaquabic Lake, Minnesota.—The granite of Kekaquabic Lake in Northeastern Minnesota, occurs in granitic and in porphyritic phases, according to Grant.[7] In both varieties the constituents are quartz, anorthoclase and other feldspars, augite, a little hornblende, biotite, apatite and sphene. The granitic variety needs no further mention. In the porphyritic phase the quartz and feldspar form a fine grained groundmass in which lie phenocrysts of feldspar and augite. An analysis of this feldspar, whose density is 2.58–2.62 gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	Total
67.99	19.27	.82	.75	.02	3.05	6.23	.90	= 99.03

The augite comprises from 5–20 per cent of the rock. Its tint varies from green to colorless, the lighter colored portion often lying within a darker outer zone. Analysis of the augite yielded:

SiO_2	Al_2O_3	Fe_2O	FeO	CaO	MgO	K_2O	Na_2O	H_2O	Total
53.19	2.38	9.25	5.15	17.81	9.43	.38	2.63	.01	= 100.23

The rock, which is an augite soda-granite, has the following composition:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	P_2O_5	Total
66.84	18.22	2.27	.20	3.31	.81	2.80	5.14	.46	tr	= 100.05

[6]Bull U S. Geol. Survey, No. 107.

[7]Amer. Geol., XI, 1893, p. 383.

Petrographical News.—In a series of articles recently published Vogt[8] discusses the formation of oxides and sulphide ores around basic eruptive rock bodies, describes all the known occurrences of the nickel sulphides with reference to their mode of origin, and reviews critically the literature treating of the differentiation of rock magmas. He shows that the nickel ore deposits that are peripheral must be due to differentiation of rock magmas. He further shows that the laws governing the processes of differentiation are very complicated and that neither Soret's principle nor any other single physical or chemical principle will satisfactorily explain the phenomena.

Dr. G. H. Williams[9] reports the occurrence of volcanic rocks at many localities in the eastern crystalline belt of North America. The rocks in question comprise tuffs, glass breccias, devitrified obsidians and fine grained crystalline flow rocks with many of the characteristics of modern lavas. All these have heretofore been regarded as sedimentary in origin by most of the geologists who have studied them. The author gives his reasons for concluding that they are volcanic, and declares that, not before their true character is recognized will the structure of the crystalline areas of the Appalachians be correctly understood.

Lang[10] discusses the conclusions of Rosenbuch[11] with respect to the chemical nature of the crystalline schists, and criticizes Linck's principles governing the mineralogical composition of eruptive rocks. In his article, which is well worth reading, the author shows conclusively that the mineral composition of rocks is not determined by their chemical composition.

[8]Zeits f. prakt. Geol., 1893, Jan., April.
[9]Journ. of Geol., Vol. 2, p. 1.
[10]Min. u. Petrog. Mitth., XIII, p. 496.
[11]Cf. American Naturalist, 1891, p. 827.

GEOLOGY AND PALEONTOLOGY.

The Cambrian Rocks of Pennsylvania from the Susquehanna to the Delaware.—Mr. C. D. Walcott has published his notes on the basal quartzites and limestones of the lower Paleozoic rocks that extend across Pennsylvania, from the Susquehanna river to the Delaware river, and across New Jersey to Orange County, New York, on the north, and into Chester County, Pennsylvania, on the east. The paper is concluded with the following brief summary of the results of the author's observations:

"The discovery of the Olenellus or Lower Cambrian fauna in the Reading sandstone practically completes the correlation of the South mountain, Chickis and Reading quartzites of Pennsylvania, and establishes the correctness of the early correlations of McClure, Eaton, Emmons and Rogers. They all considered the basal quartzite as the same formation from Vermont to Tennessee; and the discoveries of recent years have proven that the basal sandstone of Alabama, Tennessee and Virginia (Chilowee quartzite); Maryland, Pennsylvania and New Jersey (the Reading quartzite); New York and Vermont (Bennington quartzite); were all deposited in Lower Cambrian time, and that they contain the characteristic Olenellus fauna throughout their geographic distribution. The superjacent limestones carry the Olenellus fauna in their lower portions, in northern and southern Vermont, eastern New York, New Jersey and Pennsylvania. To the south of Pennsylvania the lower portions of the limestones appear to be represented by shales, and the upper and middle Cambrian faunas are found in the lower half of the Knox dolomite series of Tennessee, and they will probably be discovered in the same series in Virginia and Maryland, when a thorough search is made for them. The same may be predicted, but with less assurance, for the northern belt of limestone crossing Pennsylvania and into New Jersey, as the limestones between the Olenellus zone and the Trenton zone represent the intervals of the middle and upper Cambrian and lower Ordovician, or the Calciferous and Chazy zones, of the New York section. The working out of the details of this section in southeastern Pennsylvania is an interesting problem, left for solution to some geologist who has the necessary paleontologic training and who will not be discouraged by the prospect of a good deal of hard work before the desired result can be obtained."

"The problem of where to draw the line in this series of limestones, on a geologic map, between the Cambrian and the Ordovician, is one that will seriously embarrass the geologist, but I anticipate that either lithologic or paleontologic characters will be discovered by which the two groups can be differentiated. If not, the limestones must be colored as one lithologic unit or formation and the approximate line of demarkation between the Cambrian and Ordovician indicated in the columnar section accompanying the legend of the map."

Geology of Bathurst, New South Wales.—Bathurst is the centre of a region of considerable geological importance, and geologists are indebted to Mr. W. J. C. Ross for a detailed account of the formations of that district. The Bathurst Plains is a tract of undulating country surrounded by hills. The Plains form an extensive granite area estimated at 450 square miles, while the hills are of metamorphic rock, probably all Silurian. To the east of Bathurst they are backed by an escarpment of Devonian quartzites and sandstones. A few of the western hills are capped by basalt resting on Gravels, indicating volcanic eruptions in the district.

In discussing the age of the Granite, the author states that it is newer than the Silurian, but its relative age with respect to the Devonian is uncertain. He is inclined to think that there have been two intrusions, one subsequent to the Silurian and prior to the Devonian; and the second disturbed the Devonian strata, converting the sandstones into quartzites. A series of veins which traverses the central mass of granite is probably connected with the second intrusion. (Quart. Journ. Geol. Soc., Vol. L, 1894.)

Fossil Tipulidae.—In a paper on Tertiary Tipulidae recently published by Samuel H. Scudder, the author describes twenty-nine new species of 10 genera of Limnobinæ and twenty-two new species of 5 genera of Tipulidæ from Florissant, Colorado, only. From facts now known Mr. Scudder concludes that three principal insect localities in western Colorado and Wyoming are deposits in a single body of water, the ancient Gosiute Lake. To the fauna of these deposits he applies the term Gosiute Fauna, in distinction from the Florissant or Lacustrine Fauna in central Colorado. No single species of the Lacustrine fauna occurs in the Gosiute, and among the few genera found in two of the localities of the Gosiute fauna, the species of each locality are distinct from those of the other.

As a summary of general results obtained from the study of these remains, Mr. Scudder submits the following propositions:

1. The general facies of the Tipulid fauna of our western territories is American and agrees best with the fauna of about the same latitude in America.

2. All the species are extinct.

3. No species are identical with any of the few described European tertiary Tipulidae.

4. Of the Florissant genera, eight out of fifteen are extinct.

5. All the existing genera, except Cladura (American) of the American tertiaries are genera common to the north temperate zone of Europe and America, and are generally confined to those regions. Hence a similar climate is inferred; at least, there are no certain indications of a warmer climate.

Mr. Scudder is fortunate in having such beautifully preserved specimens with which to illustrate his paper. The delicate appendages, the markings and venation of the wings, and even the facets of the compound eyes are shown. The reproduction of the drawings of such delicate fossils reflects great credit upon the lithographer. (Proc. Amer. Philos. Soc., Vol. XXXII.)

Diatoms.—A deep-sea dredging in the Atlantic Ocean, off Delaware Bay, yielded 145 species of diatoms comprising not only marine forms, but a large number that are known to be fresh-water, and some found hitherto only in a fossil state. They were submitted to Mr. Albert Mann for examination, who reports an entire absence of new species. This fact, taken in connection with the depth of the water (318 fathoms), and the number and variety of species, leads the author to conclude that the deposit is composed of fine detritus sifted down upon the sea bottom, and conveyed there by currents from a considerable distance. A list of the genera and species is given, with references to the drawings and descriptions in published works by which they were identified. (Proceeds. U. S. Natl. Mus., 1893.)

Scott on Agriochoerus.—Some fragmentary skeletons of Agriochœrus, associated with the teeth from the White river bad lands of South Dakota, have confirmed a conjecture made by W. B. Scott that Artionyx O. & W. is a synonym of Agriochoerus Leidy. This new material permits Dr. Scott to determine the relation that Agriochœrus bears to the Oreodontidæ, by comparing the points of resemblance and difference. These are given in detail and then summarized up in the following paragraph:

"In brief, the dentition and skeleton of Agriochœrus shows a large number of close correspondences with the oreodonts, and especially in those particulars in which that group differs from other artiodactyl families. On the other hand, there are significant deviations from the oreodonts, which are to be found more particularly in the structures correlated with the curious change in foot structure. It seems on the whole highly probable that the two families are not distantly related, especially if the somewhat intermediate character of Protoreodon be considered."

The conclusion arrived at by Dr. Scott as to the systematic position of Agriochœrus is that it is the last term in a succession of species which form a curiously specialized offshoot of the Oreodontidæ, its divergences from that family being principally the results of a change in the functions and uses of the feet. (Proc. Amer. Philos. Soc., Vol. XXXIII, 1894.)

The Atmosphere as a Factor in Dynamical Geology.—The line of inquiry pursued by Mr. J. A. Udden, concerning the work performed by the winds of the atmosphere is important since this subject has not received any searching attention from the geologists of this country. The author states a series of laws which appear to govern aerial erosion, transportation and sedimentation in general, and gives the data from which these laws are formulated. The similarities and differences of wind and water erosion and transportation are pointed out, and estimates, based on experiments, of the relative values of the work accomplished by each. From these considerations important deductions are drawn. (1) Since the velocities in the atmosphere are greater than those in water, the distances over which materials may be transported in it are correspondingly greater. (2) The depth of the aerial ocean renders it but little dependent in its movements on the elevations of the land. (3) While the conditions requisite for aerial erosion are limited to rather small areas on the land of the globe, deposition is much more general and widespread. Hence accumulations of atmospheric sediments are insignificant, as a rule, only accumulating in exceptional cases.

In conclusion, Mr. Udden suggests that from a dynamical point of view the wind theory would appear to furnish an adequate explanation of the occurrence of the loess in the Mississippi valley, at least as to most of its phases, and gives the following facts as the basis of the suggestion:

"The recent denudation of the western plains, of the bad lands, and of the Cordilleran plateau is extensive enough to furnish the materials many times over. The different rocks in these regions, and the changeability of the atmospheric currents would combine to bring together and thoroughly mix a variety of materials, like those of which the loess is composed. The winds would naturally distribute over wide areas the heterogeneous but uniform mixture thus produced. When not taken close to exposures of other materials ninety-nine per cent. by weight, of the loess, is composed of particles below the size of .1 mm., and it contains only a small proportion of the finest materials common in clays and residuary earths, just as must be the case in an atmospheric sediment. It is best developed along the westernmost north-and-south drainage valley, that of the Missouri-Mississippi river. Almost everywhere it is heaviest nearest the water-courses. (Journ. Geol., Vol. II, 1894.)

Geological News. PALEOZOIC.— According to Mr. Winslow, the Coal Measures of Missouri occupy the whole western and northwestern portions of the State and embrace an area of 25,000 square miles. This region is a plateau of moderate elevation in which denudation has not progressed very far. The strata have a slight dip to the west. Their estimated maximum thickness is 1900 feet. The coals occur in basins of limited dimensions, and are chiefly bituminous in character. The beds range in thickness from one inch to about five feet.

MESOZOIC.—Forty-six additions have been made to the Cretaceous paleobotany of Long Island through the researches of Prof. Hollick. Of these nine are recognized as new species and are described and figured in the Bull. of the Torrey Botanical Club for 1894.

A new Plesiosaur, *Cimoliosaurus caudalis*, is described by Captain Hutton. The specimen, now in the Canterbury Museum, was found in the Cretaceous rocks near the Waipara river in New Zealand. It represents an animal about the size of *Pleisosaurus australis*, and is distinguished by the long and powerful tail. (Trans. New Zeal. Inst., 1893.)

Two new and interesting forms of Reptiles have been added to the group from the Elgin Sandstone described by Prof. E. T. Newton. One is a small Parasuchian Crocodile, allied to Stagonolepis, and is named *Herpetosuchus grantii;* the other reptile Prof. Newton considers intermediate between the Dinosaurians and Crocodilians, and refers it provisionally to the Theropodous Dinosauria under the name *Ornithosuchus woodwardii.* (Proceeds. Roy. Soc., Vol. 54, 1893.)

CENOZOIC.—The reports upon evidence as to glacial action in Australia are as follows: In Queensland and New South Wales, while there is both stratigraphical and biological evidence of a Pluvial epoch, it cannot yet be demonstated whether this epoch belongs to Plistocene or Pliocene time. For Victoria the evidence is equally unsatisfactory. In Tasmania and South Australia glacial action is demonstrated beyond a doubt by the researches of Mr. Johnson, Mr. Montgomery and Prof. Tate. In New Zealand, according to Captain Hutton, the evidence is confined to moraines, surface-till and "roches moutonnées." These indicate that during the ice-age there was an extension of the valley glaciers of the South Island, but there is no proof that they reached the sea. (Proc. Austral. Assoc. Adv. Sci., Adelaide Meeting.)

Mr. E. H. Williams' investigations of the extramorainic drift between the Schuylkill and the Delaware, result in the conclusion that the great moraine was formed immediately after the withdrawal of the ice from the Lehigh, and that it and the extramorainic deposits of the region were part of the same ice invasion, which was of recent age and short duration. (Bull. Geol. Soc. Am., Vol. 5, 1894.)

A tabulated list of the species of Coleoptera prepared by Dr. Scudder shows the effect of the Glacial Period on the present fauna of N. America. The list comprises the species east of the Rocky Mountains, with the exception of the "barren ground" of the high north, the immediate vicinity of the Rocky Mountains and the extreme south of Florida and Texas. West of the Sierra Nevadas the region is limited on the south by Los Angeles, and on the north includes Vancouver Island. In both of these areas, one of which may be termed the glaciated, the other the driftless, a comparison is instituted between the northern and southern regions of each to discover how many genera and species are common to both, and how many peculiar to each. In the eastern area the terminal moraine is the dividing line; in the western, the northern part of California. Finally, the results of these comparisons are balanced with each other. This, according to the author, should be a guage of the effect of the Glacial Period upon the present faunal distribution of life. The tables indicate that on the whole the fauna of the East has nearly or quite recovered from its enforced removal from the northern States and Canada at the time of the Glacial Period, and that the Glacial influence is seen now only in minor features, such as boreal faunas lingering in favorable spots amid temperate surroundings, and the similar features induced by the latitudinal trend of our great mountain chains. (Am. Journ. Sci., Vol. XLVIII, 1894.)

Among the fossils recently found in the cavern de L'Herm (Ariège), France, are two that M. Boule considers worthy of special attention. The first is the lower jaw of a Glutton (*Gulo luscus*), the other the left inferior mandible of a *Felis* of enormous size. A comparison of the former with fossil Gluttons from other caverns in France, and the Ferest-bed of England, shows a difference in size only. This, M. Boule thinks, does not warrant the new species name, *Gulo spelæus*, applied to it by Goldfuss. M. Boule is opposed also to making a distinct species of the Cave Lion, preferring to consider it a varying form of *Felis leo*, and agrees with the English paleontologists in designating it *Felis leo* var. *spelæa*.

ZOOLOGY.

A New Etheostoma from Arkansas.—*Etheostoma pagei* sp. nov. Head 3½ in length of body; depth 4 to 4¼; eye 3½ in head; snout 3½; dorsal fin with nine or ten spines and 12 or 13 soft rays; anal spines 2; soft rays 7; scales 8–56 to 61–13.

Body robust, snout abruptly decurved but not blunt; mouth rather large terminal, maxillary reaching vertical from pupil; premaxillaries not protractile; lips thick; gill-membranes not connected; cheeks, opercles and breast naked; nape scaled: lateral line imperfect, developed on only about 12 scales.

Color of male: belly bright red, extending on sides to upper rays of pectoral fins; above the red is a yellowish band on the sides about as wide as diameter of eye; upper part of body olivaceous with darker markings, each scale being provided with a black spot, these making faint lateral streaks along the rows of scales, about 9 dark blotches on the side, resembling faint bars. Caudal and soft dorsal fins barred; pectorals faintly barred; anal ventrals plain; a dark numeral scale. The female has the underparts whitish, the sides olivaceous, much mottled with darker; otherwise as in the male.

Length, 2 inches.

Only the types known. Two specimens taken in the spring branch on the U. S. Fish Hatchery grounds, at Neosho, Missouri.

(Named for William F. Page, Superintendent of U. S. Fish Hatchery, Neosho, Missouri.)—S. E. MEEK.

Immunity of Salamanders in Respect to Curare.—In a paper read before the French Academy of Sciences, March 14th of this year, MM. C. Phisalix and Ch. Contejean demonstrated that salamanders have the power of resisting, to a remarkable degree, the action of certain poisons, particularly that of curare. A salamander weighing 28 grammes, was completely curarised only after receiving 43 millegrammes of curare, a quantity sufficient to poison 80 frogs. This immunity exists, but to a less degree, in the larva of the salamander, and to a still less degree in the tadpole of the frog. In order to study the cause of this immunity, the authors undertook a series of experiments. Their researches were conducted on the theory that there might exist a relation between the presence of venomous glands and this immunity, since the resistance of the toad is greater than that of the frog. In such a case, the immunity of the salamander would be due to the presence in its blood of a substance which would be an antidote or would neutralize the effects of curare. To verify this hypothesis, they innoculated a frog with the blood of a salamander, and obtained the following results:

1. The mixture of the blood of a salamander and curare in the proper proportions does not affect the frog.

2. The blood of the salamander provokes a physiological reaction antagonistic to curare.

These results show that the blood of the salamander contains a substance anti-toxic to curare; this substance exercises a protective action not only over the animal which secretes it, but also over the frog, in which it produces a true physiological reaction against curare.

The experiments of MM. C. Phisalix and Contejean were made in the laboratory of comparative physiology which is in charge of M. Chauveau, of the Museum of Natural History of Paris. (Revue Scientifique, 1st Sept., 1894.)

List of Ophidia found near Vincennes, Indiana.—I do not offer the following as a complete list of the snakes to be found in the neighborhood of Vincennes, but have included only such as I have taken myself. The region was once a very paradise for the herpetologist, but in the past few years many large swamps have been drained and cleared and animals once common are now rare, if not wholly exterminated. Still a more careful search would doubtless lengthen my list considerably.

The *Ancistrodon contortrix*, *Sistrurus catenatus* and *Crotalus horridus* were certainly once abundant, and are still *reported* as numerous, though I have never succeeded in finding a specimen of any one of them, and therefore do not include them in my list.

1. *Carphophis amoena* (Say), found under overhanging rocks.
2. *Farancia abacura* (Holb.), swamps.
3. *Bascanium constrictor*, numerous.
4. *Diadophis punctatus* (Linn.) found in rotten logs; rare.
5. *Liopeltis vernalis* (DeK.), abundant.
6. *Cyclophis aestivus* (Linn.), abundant.
7. *Storeria dekayi* Holb., among high grass in swamps.
8. *Storeria occipitomaculata* (Storer), stony ground.

9. *Coluber vulpinus* (B. & G.), pugnacious and regarded with superstitious dread.

10. *Coluber guttatus* (Linn.), found in dusty roads; enters yards and gardens at night.

11. *Coluber obsoletus* (Say), decidedly reddish from the blotches on base of scales. Have found it only on trees. Hisses with considerable force. A captive ate sparrows, but declined mice and eggs.

12. *Natrix leberis* (Linn.), "striped water snake."

13. *Natrix kirtlandii* (Kenn.), "spread head;" rare.

14. *Natrix sipedon* (Linn.), large; typical variety of our most common snake; variously colored. I found one that would flatten its head and anterior portion of its body like the *N. kirtlandii* or the *Heterodon platirhinus.* I have seen the two extremes of color, the reddish brown and the black spotted in the brood of one female captive.

15. *Heterodon platyrhinus,* common. A friend found a spotted and a uniformly colored specimen copulating and kept them, hoping to raise a family of cross breeds, but his neighbors threatened to prosecute him for keeping such venemous serpents in town, and at length some one broke open his box and killed the "deadly spreading adders." The snakes were strictly diurnal in their habits. They were voracious and preferred toads, but when pressed by hunger would eat frogs and small snakes.

16. *Ophibolus doliatus* (Linn.) common. A boy killed one in the woods, and I went out to examine it, and found beside the dead snake a live one of the same species. It was examining the body and showed fight when disturbed. Was it a mourner guarding the corpse, or a ghoul disturbed at its feast? I do not know.

17. *Ophibolus getulus,* less common.

18, 19, 20. *Eutainia saurita, radix* and *sirtalis,* the latter in great variety.

Mr. Robert Ridgway says that he was informed that the *Ancistrodon piscivorus* (LaC.) was abundant about Vincennes. He was probably misinformed.

The *Natrix sipedon* is called the " water moccassin " in this locality, and is much dreaded. A man near here is reported to have died recently from the effects of its bite, aud, strange to say, this story is believed.

The coral snake, *Elaps fulvius,* has been twice reported from this State, but no one in this locality, so far as I can learn, has ever heard of such an animal.—ANGUS GAINES.

38 Locust St., Vincennes, Ind.

Zoological News. — Mollusca. — According to MM. Bornet and Flahault, the chief cause of the disappearance of shells in quiet bays where they are not subject to wave action is the constant gnawing away of the calcareous matter by shell-boring algae and fungi. Ten genera of boring plants are described, and, in some cases, the life-histories are narrated. (Bull. Soc. Bot. France, t. 36.)

Pisces.—The Bull. U. S. Fish. Com. for 1892 includes a paper by Dr. Eigenmann on the viviparous fishes of the Pacific Coast of North America. The author reviews the Embiotocidae, gives a bibliography of the viviparous fishes, and a detailed accout of the development of Cymatogaster from fertilization to hatching, and the details of the development of the intestine and Kupffer's vesicle. Outlines of the post-embryonic development are also presented.

According to Dr. Gill, the proper generic name of the Tunnies is Thynnus. A discussion of the question is followed by a list of the synonyms. (Proceeds. Natl. Mus., Vol. XVI, No. 965.)

The same author has published a provisional arrangement of the families and subfamilies of fishes which includes the names of the proposers and modifiers of family names with the dates of naming. (Sixth Mem., Vol. VI, Natl. Acad. Sciences.)

Mammalia.—Dr. J. A. Allen calls attention to the cranial variations due to growth and individual differentiation, and instances the species *Neotoma micropus* as a case in point. In a series of fifty skulls of this species it would be easy to select extremes that depart so widely from the average in one or more characters that they might readily be supposed to represent distinct species. Hence the determination of the status of a species described from one or two specimens must depend upon the subsequent examination of a large amount of material bearing upon this and its closely-related forms. (Bull. Am. Mus. Nat. Hist., Aug., 1894.)

ENTOMOLOGY.[1]

Biology of the Glowworm.—Some interesting observations on the New Zealand Glowworm (*Bolitophila luminosa*) are recorded by A. Norris.[2] The larvæ secrete a mucus, on which they slide, leaving a mucus track like the snail. The mucus is also used to make luminous webs. "When the larva is making a fresh web, it raises its head and the first four or five segments in the air, and reaches round about till strikes something. It then draws its head back a little way, thus making a very fine thread of mucus. It then passes it to the thick mucus on the first segment, then slides out a little way and makes another thread on the other side in the same way, fastening each to the thick mucus on the body. When it has made a sufficient number of these braces, it begins to make the strings of beads which hang downward from these braces by gliding out on the braces and lowering its head and about half the body. It then works its head up and down as if to vomit. You can see the mucus gathering on the body. Then it draws its head right back into the first two segments, as if it were turning inside out. It then catches hold of the mucus on the edge of the segment and forces it forward. Now the head is out straight, with a large drop of mucus all round it, like a drop of water. Then it draws its head gently out of the mucus, thus making a short, fine thread from it. It then makes another drop and another short thread; then a drop and so on until it has made several of these pendents of beads, which vary in length. I have seen them from one inch to four or five inches." In the small caves where the larva lives, these webs reflect the light from the shining glowworm.

Mr. Norris believes the webs are formed to entangle insects and Crustacea, as he has found many of these dead in the webs, and some were hollow as if the body contents had been eaten. "When the insects are alive, the larva may be seen smothering them with mucus." One was also seen actually feeding on the inside of a Crustacean.

Embryonic Development of Tortrix.—As a result of recent studies of *Tortrix ferrugana*, J. W. Tutt says:[3] "It appears certain that

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Ent. Mon. Mag., Sept., 1894.

[3] Ent. Record, V, 215, Sept., 1894.

there are in its embryo four distinct cephalic segments, which, in the early stages of embryonic development are large (compared with the other segments which are developed later), and are made still more distinct by the possession of buds or processes. As development goes on, these four segments get welded together, and become not only proportionately, but absolutely smaller than at first. When the abdominal segments are in course of development, there certainly appear to be eleven of them. The three thoracic segments are, in the early stages of development, large and almost circular, and the next segment (1st abdominal) is of the same character, looking at this time much more like a thoracic than an abdominal segment, though it has, of course, no appendages. The eye spots in this species are remarkably conspicuous as two reddish patches, and become apparent at about the same time that the abdominal segments first show. As development proceeds, the cells of the developing *T. ferrugana* appear to be stained here and there with red patches, especially along the ventral area of the alimentary canal, but differently distributed in different examples. These afterward spread over the whole of the embryo." It was suggested that this color was connected with the skin. The thoracic legs develop when the embryo begins to show segmentation. The embryo is then somewhat curved, " with the head slightly bent round toward the anal extremity, but with the legs outside, *i. e.*, the larva is bent back upon itself so as to form a curve agreeing roughly with the curvature of the shell, with what afterwards becomes the ventral surface of the larva outside and the dorsum towards the centre. The embryo then gradually changes its position, the anal segments curling around and being pushed by the growth of the preceding abdominal segments slowly up the ventral surface of the larva whilst the dorsum gets pushed out, as it were, towards the centre of the egg. During this process the embryo becomes shaped something like the letter S, the movement continuing until a complete reversal of the embryo has been affected."

The Rabbit Bot Fly—Cuterebra cuniculi Clark.—We are greatly indebted to Mr. Percy Selous, of Greenville, Mich., for specimens, notes and drawings of the rabbit bot fly, *Cuterebra cuniculi*. The larva of this species is quite often taken from the rabbit, though few persons are successful in rearing the fly from the larva, and Mr. Selous is to be congratulated on his success.

The notes of Mr. Selous on the rearing of the bot are as follows: 'The ripe larva dropped from a rabbit I shot last September. The grub was between the fore legs rather high up, and when expelled, the pocket in which it had lived had just the appearance of the interior of the anus in mammals. I took the grub home and let it burrow into a box of earth from which the fly emerged, something like what I have shown in my sketch, on the 22d of May. As a naturalist, I am deeply interested in such matters as this, and the fact that I have been able to follow my bent in South Africa, South America and many other countries does not tend to make me less so."

The grub, as shown by Mr. Selous in the accompanying drawings, is over an inch and a half long and nearly an inch broad. The pupa case is very thick and heavy, with blunt, thick-set tubercles covering the outside of it. The fly has the head, legs, ventral region and all of the abdomen, except the first segment, black. The thorax and the first segment are thickly covered with fine silken yellow hair. The wings are dark and smoky.

This species of grub is quite common in the front quarters of rabbits this time of the year, and no doubt if more hunters and naturalists knew of its presence in the rabbit and how to save and rear the grub, more of the flies might be reared. Mr. Selous has made a start; who will follow?—G. C. DAVIS. Agr'l College, Mich.

Insects' Vision.—Mr. A. Mallack adds another paper to the voluminous literature of vision in insects.[4] His observations and calculations, as we learn from the "Journal of the Royal Microscopical Society," have led him to conclude that "Insects do not see well; at any rate, as regards their power of defining distant objects, and their behaviour, favors this view. They have, however, an advantage over simple-eyed animals in the fact that there is hardly any practical limit in the nearness of the objects they can examine. With a composite eye, the closer the animal the better the sight, for the greater will be the number of lenses employed to produce the impression. In the simple eye, on the other hand, the focal length of the lens limits the distance at which a distinct view can be obtained. Of the various forms of insects examined, the best eye would give a picture about as good as if executed in rather coarse wool-work, and viewed at a distance of a foot."

Chinch Bug Diseases.—Professor F. H. Snow makes an elaborate report[5] of his recent extended experiments with the fungus Sporo-

[4] Proc. Roy. Soc. Lond., LV, pp. 85–90.

[5] Univ. of Kansas Exp. Station, Third Rept., 1894.

trichum which causes a fatal malady of chinch bugs. More than three thousand experiments are reported, more than half of which were believed to be successful. The great difficulty in the practical use of the fungus was the dry weather, during which no progress could be made.

Greenland Insects.—In reporting on a small collection of Microlepidoptera from McCormick Bay, Professor C. H. Fernald remarks:[6] "One of the most interesting features of this small collection is the very dark color of the insects. The specimens of *Laodama fusca* and also of *Pyrausta torvallis* are much darker than any I have ever seen before, either of those taken in New England or Labrador, but when we recall that Mr. Mengel states that they rest on the lichen-colored rocks, we have not far to seek for the cause of this dark color." These lichens are dark brown or black, and the laws of natural selection would lead to the establishment of a dark race through the elimination of the light-colored individuals. Professor Fernald describes one new species —*Sericoris mengelana.*

Habits of Larval Coleoptera.—F. M. Webster reports[7] that larvæ of *Leptotrachelus dorsalis* Fab. feed on larvæ of *Isosoma tritici* Riley, and pupate in wheat stubble, after plugging up open end. The larva of *Phalacrus politus* Mels. develops in smut of rye and Indian corn. A female *Neoclytus erythrocephalus* was seen ovipositing in trunk of dead apple tree, and *Bruchus mimus* Say was reared from seeds of *Cercis canadensis.* The larva of *Disonycha caroliniana* Fab. feeds on foliage of *Portulaca oleracea,* and *Apion segnipes* Say develops in pods of *Tephrosia virginiana.*

Biology of the Horse Bot.—From observations on the eggs of the common horse bot fly, Professor H. Osborn reaches the following conclusions:[8] "(1) That the eggs do not hatch, except by the assistance of the horse's tongue. (2) That hatching does not ordinarily occur within ten or twelve days, and possibly longer, or, if during this period, only on very continuous and active licking of the horse. (3) That the hatching of the larvæ takes place most readily during the third to fifth week after deposition. (4) That the majority of the larvæ lose their vitality after thirty-five to forty days. (5) That the larvæ may retain their vitality and show great activity upon hatching

[6] Ent. News, V, 132.

[7] Ent. News, V, 140.

[8] U. S. Dept. Ag., Div. Ent., Bull. 32, p. 48.

as late as thirty days after the eggs were deposited. (6) That it is possible, though not normal, for eggs to hatch without moisture or friction. (7) That in view of these results, the scraping off of the eggs or their destruction by means of washes will be very effective, even if not used oftener than once in two weeks during the period of egg deposition, and probably, that a single thorough removal of the eggs after the period of egg deposition has passed, will prevent the great majority of bots from gaining access to the stomach."

PSYCHOLOGY.

Subjective Defense in the Lower Animals.—In this paper I use the word "defense" in its broadest sense, not only as the antethesis of offence, but in the sense of protection. The instinct of defense or self protection is greatly developed in the lower animals, so much so, that the observant naturalist finds evidence of it even in microscopic organisms.

On one occasion I opened the burrow of an itch insect (*Acarus*), and allowed the serum to float out the little parasite which dwelt therein. I could, with the assistance of a good French lens (X 15 diameters) closely see it moving along on the surface of the skin. I touched it with the point of a needle, and at once it stopped all motion and feigned death. In a few moments the little animal regained its feet and slowly moved off, only to again feign death as soon I touched it with the needle. This habit of letusimulation (*letum*, death, and *simulare*, to feign), I have noticed in much lower animals, and am convinced that they make use of this strategy for the purpose of self-protection.

A minute fresh water animacule (rhizopod) retracts its hair-like feet, feigns death and sinks, whenever its enemy, a water louse, approaches it. I have witnessed this occurrence on several occasions, and have, likewise, seen Rhizopoda return to their feeding-grounds as soon as their enemy has disappeared. A fresh-water worm practices letusimulation when approached by the giant water-beetle, and many of the microscopic infusory animalcules likewise make use of the same sagacious subterfuge when surprised by their enemies. Death-feigning is practiced by most of the slow-moving beetles, especially is this noticeable in the tumble-bug and bombardier-beetle. This last-mentioned insect, notwithstanding its disgusting odor, is the favorite food of some of the birds, noticeably, the jay and the cardinal. They will not touch it if killed and offered to them; numerous experiments have taught me that these birds regard it as unsuitable food unless taken alive. There is, probably, some *post-mortem* change in the juices of the beetle, which renders it unpalatable. The object of letusimulation in this beetle is made perfectly obvious. In a paper on "Animal Letusimulants," published in the March number of *Atlantic Monthly*, I account for the origin of death-feigning in animals, as follows: "Most animals are slain for food by other animals: there is a continual struggle for existence. Most of the carnivora and insectivora prefer freshly killed food to carrion. It is a mistake to suppose that carnivora prefer carrion, though the exegencies of their lives in their struggle for existence often compels them to eat it. Dogs will occasionally take it, but sparingly, and apparently as a relish, just as we ourselves eat certain odoriferous cheeses. Carnivora and insectivora would rather do their own butchery; hence, when they come upon their prey seemingly dead, they will leave it alone and go in search of other quarry, unless they are very hungry. Tainted flesh is a dangerous substance to go into most stomachs, certain ptomaines rendering it, at times, virulently poisonous. Long years of experience have taught this fact to animals, therefore, most of them let dead or seemingly dead creatures severely alone."

The larvæ of many of the moths and butterflies are pronounced letusimulants. In fact, I may say that all edible larvæ practice this cunning trick. Take a caterpillar in the fingers, or touch it with a stick, and it will at once curl up and feign death. They invariably assume that shape which *rigor mortis* occasions in real death. Mr. George D. Mattingly, of Owensboro, Ky., related to me the following instance of letusimulation in a caterpillar: This larva had fallen accidently into a conical depression in a sand-heap. It attempted to crawl up the north side of the pit, but, owing to the rolling of the sand beneath its feet, slipped back. It then tried the west side, and almost reached the top. Here, however, it dislodged a lump of agglutinated sand-grains, and rolled, together with the lump, to the bottom of the hole. The caterpillar, imagining the clod of sand to be an enemy, at once curled up and feigned death. It remained quiescent for several minutes, then tried the south side, mounted safely to the top, and went on its way rejoicing. The fact that this larva tried three different routes before reaching the top, shows a high degree of conscious determination. Many of the thousand-legs have this habit, and practice it whenever the occasion demands. The toad is a gifted letusimulant; when it sees that it cannot escape its enemy, it ducks its head, draws in its legs close to its body, and feigns death. It may be turned upon its back, or thrown to some little distance, or handled freely, yet it will give no sign of life, unless pain be inflicted.

Some of the snakes have acquired this habit, notably the moccasin (*Ancistrodon*). Last August I discovered a moccasin in an open field where there were no sheltering rocks, bushes, weeds, etc. I teased it for quite a while with my stick, driving it back whenever it attempted to escape. Suddenly it bent its body backwards and seemingly inflicted a severe bite on its own back. Immediately it turned over on its back, belly upwards, to all appearances dead. I retired some little distance and seated myself on the ground. After five or six minutes the snake turned upon its belly and glided rapidly away.

Mr. John Cheatham, of Owensboro, Ky., informs me that on September 23, he and Mr. John Harrison came suddenly upon a black or blowing-viper in a field. Mr. Harrison remarked that he could make the snake commit suicide; whereupon, he picked up a long stick and began to annoy it, driving it back whenever it endeavored to escape. In a few moments "the snake bent back and drew his widely open mouth violently along his body as if endeavoring to rip himself open. He then turned upon his back and died at once." This act of letusimulation was so perfect that Mr. Cheatham and friend walked away, thoroughly convinced that they had seen a suicide enacted. It is hardly necessary to remark that the snake in question is perfectly harmless, having neither fangs nor poison glands. Many of the higher animals make use of the simulation in order to deceive their enemies or their prey.

The Criminal Skull.—I give a figure of a model in clay of the skull of Jeff. Diggs who died at the age of fifty, having passed, according to his own statement, thirty years of his life in reformatories, workhouses, jails and penetentaries. This model is made to scale and is

The Criminal Skull.

exact in every particular. A Photograph of the original skull does not bring out the detail, hence I made the model in clay. It should have accompanied the text of "The Recidivist," American Naturalist, June, 1894, but an injury to my right hand prevented a completion of the model in time.

POINTS TO BE NOTED.

1. Flattening of the cranial arch.
2. Shallowness of brain-pan.
3. Dolichocephalism.
4. Prognathism.
5. Enlargement of orbital arches.
6. Smallness of orbicular cavities.
7. Highness of cheek bones.
8. Bowing of zygoma.
9. Sagging of occiput.
10. Heaviness and projection of lower jaw.
11. General asymetry of skull.
12. Resemblance to the prehistoric skull of the Man of Spy.

See "The Recidivist" American Naturalist, June, 1894.

JAS. WEIR, JR., M. D.

The Habits of Amblystoma opacum.—I once secured a number of marbled salamanders (*Amblystoma opacum*), and kept themin a small enclosure where they lived under chunks of wood. They did not curl up as they are said to do, but lay stretched out, showing but little sign of life. Their food was larvæ and earthworms; I believe they will not eat flies nor ants. They are so soft, weak and helpless, that I thought that they could not dig deeper than merely sufficiently to hide themselves, but, out of deference to the opinion of Mr. Nicholas Pike, who says that they will burrow to a depth of three feet, I sunk a board two feet deep around their enclosure. I was absent for a time, and returned to find my salamanders missing. On digging carefully, I found unmistakable signs of their burrows extending beneath the sunk board. They had burrowed out and escaped, corroborating two feet of Mr. Pike's story.—ANGUS GAINES.

Habits of Ophibolus getulus.—Early in July I captured an *Ophibolus getulus*, a small but very fine specimen, answering perfectly to the description of the type given by Dr. O. P. Hay, in the Seventeenth Annual Report of the Indiana Geologist.

The little reptile fought fiercely when first picked up, but was perfectly docile the next day. I kept him in an enclosure with a number of other snakes of various species, but he appeared to dislike their society and appeared reluctant to share their bed of loose cotton. He refused all food and took no notice of the earthworms, insects, minnows and small frogs and toads with which my other snakes were fed, and paid no attention to a *Natrix sipedon* much smaller than himself. When placed in a box with a large number of small toads, he appeared frightened and tried to escape. Acting upon a suggestion offered by Professor Cope in his article on "Critical Review of the Characters and Variations of the Snakes of North America," I kept him supplied with a saucer of milk, of which he took no notice.

After he had been in my possession for 25 days, I captured a *Eutænia radix* which I put in the same enclosure. The other snakes paid no attention to the newcomer, but the *Ophibolus* roused at once, as if scenting a natural enemy, and seized the *Eutænia*. The fight was long and fierce, for the *Eutænia* was strong and active, and was five inches longer than his assailant, but the *Ophibolus* gained the victory and undertook the seemingly impossible feat of swallowing his victim. This task occupied the whole night, but he actually succeeded in swallowing the snake five inches longer than himself. This very hearty meal distorted him beyond recognition, and he gave no signs of life except by a slight twitching of the tail. After an absence of some 40 hours I revisited my terrarium, and found that he had disgorged his prey and resumed his proper shape.

Since that time the *Ophibolus* has taken no food, though he is still strong and active; his spots, however, which were originally of ivory whiteness, have assumed a sulphur yellow hue.

I tried placing a looking-glass in my terrarium, and the *Ophibolus* showed signs of excitement at the first sight of his reflection, but afterwards paid no attention to it.

My *Ophibolus getulus*, 12½ inches long, after going fifty days without food, except the one snake which it subsequently disgorged, killed and ate a *Natrix sipedon* over eight inches long, and is doing well.

—Angus Gaines.

ARCHEOLOGY AND ETHNOLOGY.[1]

Indian Corn in Italy.—Some Italian Naturalists like Bonafous (Hist. Nat. Agric. et Economique du Mais, Paris and Turin, 1836) have supposed that Indian Corn (Zea Mays) had grown in Asia or Africa before the Spaniards found it in America, but De Candolle (L'Origine delle piante Coltivate, Milan 1883, p. 519) believes that it came into the Old World from the New after the discovery by Columbus, and that Rifaud, who in 1819 found maize in an Egyptian tomb at Thebes, was deceived by an Arab.

Signor Goiran, of Verona, supposes that the plant was first largely cultivated near Verona about 1647, and Signor Anelli, the inventor of "Anellis maize-bread," informs me that it was not used for human food in the Milanese until about 1817. Harschberger in his recent important investigation of the history of the grain (Zea Mays—A Botanical Study, Philadelphia, 1892) while tracing the source of the American grain to Southern Mexico does not believe in its extra American origin, but whether we may suppose it to have grown in any corner of the Old World before 1492 or not, there is no question that the Spanish discoverers brought specimens of it from America to where it was noticed in cultivation near Seville about 1527. How it got into Italy from Spain, (granted that it came thence) whether directly, or by the roundabout way of Arab commerce through Morocco, Africa and the Levant, no one seems to have informed us, though if by the latter route, we may guess that it found its way into Lombardy through Venice.

However and whenever it appeared on the Lombard plain, the well preserved architectural decorations, frescoes, paintings and book illuminations of the fifteenth and sixteenth centuries in Italy might throw an unexpected light upon the date and direction of its first importation. The frescoes of Mantegna (1451–1517) often adorned with borders of plants and flowers might reveal maize. There is no maize, I am informed, among the plants and fruits painted on the leaf margins of the magnificent 15th century Missal known as the Breviario Grimani by Hans Memling (died before 1499) at the library in Venice; and I failed to find signs of the use of Indian Corn in the farmyard pictures of Jacopo Bassano (1510–1592) at Venice and Verona, or in the throng of stooping figures and animals by him known as "The Fair" at Bassano, where

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

the turkey appears then as new and as American as maize. I found it, however, abundantly used in the Stucco ceiling decorations (by Vittorio, middle of 16th century) of the Villa Masser near Castel Franco.

If there remains any doubt as to the genuine antiquity of the grains in Rifaud's Egyptian tomb no better evidence for or against the American origin of the plant now grown in Europe could be looked for than what these unransacked pictures and ornaments may offer, where at slight pains and by a turn of the head, any traveller will settle the question beyond all dispute if he discovers maize in color or stone before 1492.

While common parlance in the Old World has so often held to a geographical name for the strange grain, dubbing it in Lorraine "Roman grain," in Tuscany "Sicilian grain," in Sicily "grain of India," in the Pyrenees "Spanish grain," in Provence "Barbary or Guinea grain," in Turkey "Egyptian grain," and in Egypt "Syrian grain," these Folk names have seemed by implication to deny, in every case, an American origin to the plant. But the fact in De Candolle's opinion proves no more than that the English name "Turkey" has appeared to deny an American parentage to the familiar *Meleagris gallopavo.*

According to Professor Keller of the University of Padua, the human consumption of maize ceases south of Bologna, and in my conversations with townspeople a slight notion of something ridiculous seemed to attach to the grain, as of a food fit for hogs and cows, rather than men. Notwithstanding this, some of the peasants eat maize in the common form of Polenta (boiled mush) to such an extent in the Novarese, Bergamasco, Milanese, Comasco, Bresciano, and Tremonese, and in Mantua, Veneto and Vercelli[2] that a sickness called Pelagra, showing itself in shrunken skin, emaciation, dizziness, intense thirst, and a desire to plunge into pools of water, is the result.

Leaving out the alcohols, oils, colors and glucose extracted from Italian maize in recent years, the most considerable and important of all the human uses of the grain in Italy is

(1) *Polenta,* the universally mill ground meal boiled with salt and water for half an hour, large doughy loaves of which, saffron yellow or white, can be found in almost any peasant's cupboard from Venice to Piedmont.

Sometimes cut slices of it are found, as I saw them at Venice, fried, like American fried mush.

[2]For this and the following information as to Anellis Bread and Pane Mistura I am indebted to the Rev. Signor Anelli of Monza.

Now and then a little maize meal goes with farina, salt and water into a soup and you have

(2) *Polentina di Cittadella.* The further uses of maize in northern Italy for human food are as follows:

(3) *Pane Giallo,* of Milan, a baked loaf made half of maize and half of wheat meal.

(4) *Pane Mistura,* of Milan and the Veronese, a baked loaf of varied shape made of one-third maize and two-thirds wheat meal.

(5) *Pane Mistura Con Uva* which is No. (4) mixed with rasins.

(6) *Foccacia,* (Fogassa, Verona city dialect; Pissotta or Pinze, Country, Veronese dialect). As I saw it made in a peasant's kitchen near Verona, it is produced as follows: Take one pint of yellow maize meal, mix it with two pints of wheat flour. Pour upon the mixture half a teacupful of melted butter; add then two tablespoonfuls of white sugar and one tablespoonful of soda; this done, pour on gradually about a half a pint of hot water and roll and knead the mass well. Finally having made the dough into a round ball, flatten it into a cake about ⅜ of an inch thick and 10 inches in diameter, both sides of which are to be well stippled with the point of a knife. Fry it then in a pan greased with about a half a teacupful of butter and raised about two inches over a pile of live but flameless embers.

(7) *Cinquantino* (Zinquantin, dialect Veronese) as eaten near Padua and Verona. This is the young, milky ear of the white variety of maize roasted near the embers.

(8) *Melica Dolce.* A small sugared cake made of maize meal in Milan.

(9) *Pane d'Anelli,* eaten in the Milanese. A mixed bread baked of two-thirds maize and one-third wheat, recently invented by the Rev. Signor Anelli, of Monza, as a cheap substitute for Pane Mistura, and as a cure for Pelagra in districts where peasants who eat maize four or five times a day suffer from the disease.

The two well known and commonly used varieties of maize in northern Italy are the bianco (white) producing a white meal but considered of inferior flavor as polenta, and the rosso (red) with a very brilliant reddish-yellow tinge on the cob, and producing a golden yellow meal.

By the tenth of September the russet fields of the ripening grain are as characteristic of the Lombard plain, as the horizon obstructing locust hedges, or the pollard trees festooned with grape vines. But the ears ripen on clipped stalks and we miss the wigwam shaped stacks of American "fodder." I saw peasants threshing maize with flails near Verona, but could hear nothing of pounding the grain with pestle and mortar. Hominy large or small and "ash" and "hoe" cakes seemed unknown, and the interesting Mexican edible products of maize like "tortillas," (wafer like cakes of baked maize dough,) or the peppered dumplings called "tomales" had no more place in the Lombard kitchen than the transatlantic art of crushing on metates the water soaked and softened grains. Near Castel Franco, I saw a large bunch of red ears hanging by their twisted husks on the wall of a roadside shrine.

An etymology has been suggested for the name Grano Turco, in the antics of boys when bearded and moustached with maize silk, they mimic the fierce looks of Turks in the high "corn." We cannot think that the Italian lad does not smoke the mock tobacco that must tempt him upon each ear. If he does he apes a habit no less American in its origin than the maize itself. So the American lad playing with a "shoe string bow" on a "corn-stalk fiddle" would turn to Italy for his inspiration.—H. C. MERCER.

MICROSCOPY.[1]

Cytological Methods.—*Lysol.*—Friedrich Reinke[2] calls attention to the antiseptic *lysol* (a solution of Cresol in neutral soap) as a valuable reagent for the nucleus. *It dissolves chromatin,* leaving other elements intact; and it brings out a new element in the nucleus, to which the author gives the name, *œdematin.* This substance appears in the form of granules within the linin mesh-work of the nucleus, remaining after the chromosomes have been completely dissolved. A small salamander larva, for example, left in about 50 ccm. of 10 per cent *lysol* for from 6 to 24 hours, will have its chromatin dissolved, and its œdematin granules rendered visible.

Œdematin shrinks greatly in such reagents as alcohol, chromic acid, and osmic acid, and only now and then appears as a *fine* granular precipitate. In lysol, on the contrary, it swells up under the action of one constituent (the soap solution) and is coagulated by the cresol and thus made distinct. Œdematin corresponds, in part at least, to Heidenhain's *oxychromatin,* Pfitzner's *parachromatin,* and Frank Schwarz's *paralinin.* Reinke remarks that this substance is absent, or nearly so, from ova and spermatozoa. It is well developed in most somatic cells: e. g., epithelium, connective tissue, leucocytes, etc.

In the action of lysol, three stages are to be distinguished: (1) solution of the chromatin; (2) appearance of œdematin granules; and (3) further changes of the œdematin.

The time required to reach the second stage varies with the tissue. The epithelium of the salamander larva requires at least six hours. In connective tissue the second stage is quite short and transitory.

The method does not admit of permanent preparations.

Neutral versus Acid Fixatives for Nuclei.[3]—Professor Altmann claims that the usual acid reagents, among which he reckons sublimate, platinum-chloride, gold-chloride, etc., disturb nuclear structure, reducing the chromatic elements to compact, structureless masses. On the other hand, *neutral* reagents, among which are placed osmic acid, and a mixture of chromic acid with a molybdenum salt, preserve the structure of nuclei. At first sight, and under low powers, nuclei present a homogeneous appearance. But this homogeneity is not

[1]Edited by C. O. Whitman, University of Chicago.

[2]Anat. Anz. VIII, Nos. 16 and 18, 1893, and Arch. f. m. Anat. XLIII, No. 3, 1894.

[3]Altmann. Verhandl. d. Anat. Ges. Mag., 1893, p. 50.

real; for structure is there and it can be made out, although with some difficulty. Cell nucleus and cell body, although chemically different, exhibit the same morphological structure, consisting of *granula* and *inter-granular net-work.* Altmann was able to demonstrate the granular structure of the chromosomes.

Heidenhain (Arch. f. mik. Anat., XLIII, 3, p. 428) maintains, in opposition to Altmann, that with sublimate the granula and net-work are demonstrable; and further, that acid reagents are, after all, superior to neutral reagents.

Iron-hæmatoxylin and Centrosomes.[4]—Iron-hæmatoxylin has been used by Heidenhain in the study of the centrosomes and astrospheres.

The original process, which is also repeated in the new modification, was the following:

Fine sections of preparations in sublimate are fixed on the slide by means of distilled water, dehydrated with alcohol containing iodine, and exposed to a 1½ per cent solution of ammonio-ferric alum.[5] The slide is next washed with distilled water and then placed in a 1½ per cent solution of *Hæmatoxylinum purissimum* (Grübler). The overstained sections are then again treated with the iron-alum solution used before, in order to remove the superfluous color. The process of extraction must be followed under the microscope and continued until the cell protoplasm is completely decolorized, and the chromatin network of the nucleus becomes clear. One may interrupt the differentiating process any moment by washing with fresh water, and then continue it. When the extraction of the stain has been carried far enough, the slide should be washed fifteen minutes in fresh water and mounted in the usual way in balsam.

Heidenhain noticed that when the differentiation was effected quickly the centrosomes were stained in greater number than when the process occupied a long time. It seemed, therefore, that the defects of the method might be corrected if a way could be found by which the decoloring process could be hastened. How could the cytoplasm be freed from the stain in the shortest time? Assuming that a stain acts by chemical combination, it seemed probable that the process of extraction might be hastened, if the receptivity of the cytoplasm could be at least partially saturated before the application of the hæmatoxylin. Accordingly, Heidenhain selected as *preliminary* stains

[4]Arch. f. m. Anat. Vol. XLIII, part 3, p. 434.

[5]The crystals of this salt should be clear violet in color; if they are yellowish and opaque, they have suffered from exposure to air and are no longer fit for use. The solution must be made cold, as the salt is decomposed by heat.

(" Vorfarben ") such as affect the cytoplasm and the nucleus, and leave the centrosomes unstained. Thus the chemical affinities of the centrosomes for the hæmatoxylin would remain at full strength, while those of the cytoplasm and nucleus would be more or less saturated, and to the same extent weakened for the hæmatoxylin. In this way the process of extraction was brought under some control, and the method greatly improved.

Stains reached in this way are called "subtractive."

Bordeau R., Anilin blue and Methyl-eosin were employed as preliminary stains. Bordeaux R. proved to be the best. In preparations that have been successfully differentiated as to the centrosomes, the nucleus and its chromatin are almost colorless, so that the centrosome may be easily studied, even when it lies behind the nucleus. The *nucleoli* remain strongly stained.

The Chromatin.—Heidenhain shows that there are two kinds of chromatin to be distinguished, namely: an *oxychromatin* brought out by *acid* anilin stains (e. g., Rubin S.), and a *basichromatin* which is brought out by *basic* anilin stains (e. g., Methyl green). The "basichromatin" is the chromatin of Flemming and authors in general.

The differentiation of the two chromatins can only be accomplished when the nucleus is exposed at the same time to both *acid* and *basic* anilin colors, as is the case when Biondi's solution and Ehrlich's triacid are used.

If one mixes ammonium vanadate with hæmatoxylinum pur (Grübler) a blue stain is obtained which stains *cytoplasm* and *oxychromatin* strongly, while the *basichromatin* is often left nearly colorless.

The two chromatins probably differ only in the amount of phosphorus present, basichromatin containing more, oxychromatin less.

The Egg-Centrosome.[6]—Dr. H. Mertens finds that the so-called "yolk-nuclei," so generally known in both vertebrate and invertebrate eggs, represent, in the case of the mammals and birds, two very different elements. Sometimes they are chromatin granules eliminated from the nucleus; at other times they represent centrosomes. The identification of these bodies with the centrosome is the point of chief interest. The method employed was as follows: The material was prepared in Hermann's fluid. Three precautions were observed: (1) The object must remain a long time in the fluid—for weeks or even months. (2) Transfer to pyroligneous acid (1–3 ds.). (3) Wash thoroughly in running water.

The preparations were imbedded in celloidin and stained with safranine.

[6]H. Mertens, Arch. de Biologie, XIII, 3, '94, p. 394.

SCIENTIFIC NEWS.

Dr. Carl Röse, so well known for his investigations on the structure and development of the teeth, has issued, in connection with Dr. A. Gysi, of Zürich, a set of twelve microphotographs of the histology of the teeth. The photographs are 18 cm. square, and are sold at 12 marks ($3.00) the set. Dr. Röse's address is Friedrichstrasse, 12, Freiburg i B, Germany.

Professor Lamson Scribner had his entire herbarium which was especially rich in grasses, stored in the Knox warehouse which was burned in August. The entire collection except the genus Panicum was destroyed.

Mr. T. H. Kearney, Jr., has been appointed Curator in the Columbia College New York Herbarium.

Dr. Harrison Allen has resigned the directorship of the Wistar Institute of Anatomy in Philadelphia, and Dr. Horace Jayne has taken his place.

Prof. Chas. T. Prosser has left Washburn College Topeka Kansas, and has taken a position at Union College Schenectady, New York.

The Academy of Sciences of San Francisco has published an illustrated volume of Proceedings consisting largely of important contributions to the zoology of Lower California.

Errata.—In the Article "Abalone or Haliotis Shells of the Californian Coast," on page 858, ninth line from top, "As these strips of solid silver," should read "As thin strips of solid silver."

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THE AMERICAN NATURALIST

A MONTHLY JOURNAL
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IN THEIR WIDEST SENSE.

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PARADISEA RAGGIANA

(From Gould's Birds of New Guinea)

THE

AMERICAN NATURALIST

VOL. XXVIII. December, 1894. 336

QUATERNARY TIME DIVISIBLE IN THREE PERIODS, THE LAFAYETTE, GLACIAL, AND RECENT.[1]

BY WARREN UPHAM.

According to definitions in text-books by Dana, Archibald Geikie and Etheridge, the Quaternary era began with the change from the mild Pliocene climate to that of the Glacial period, with its accumulation of the vast sheets of land ice in high latitudes, and has continued to the present time. We are living in the Quaternary era, as thus defined, and it must extend far into the future to be at all proportionate in length with the previous co-ordinate divisions of geologic time. Le Conte and Prestwich, however, consider the Quaternary division of time as completed at the dawn of civilization, with traditional and written history; and they assign recent geologic changes to a new era, named by Le Conte the Psychozoic, which is separated from the preceding principally on account of the supremacy of man. The former view seems preferable, because man is known to have been contemporaneous with the Ice age.

Quaternary time, therefore, is here assumed to include (1) the period of changed conditions causing the accumulation of

[1]Presented before Section E of the American Association for the Advancement of Science at the Brooklyn meeting, August 20, 1894; also partly contained in a paper read before the Geological Society of America, August 16, 1893, as published in its Bulletin, Vol. V, pp. 87-100, January, 1894.

the ice-sheets; (2) the Glacial period, when the glacial and modified drift were formed; and (3) the Postglacial, Recent, or Present period, extending from the departure of the ice-sheet until now. The first and second of these periods, which were comparatively long, constitute the Pleistocene division, while the third and very brief period is the Present or Psychozoic division, of the Quaternary era.

The Lafayette Period.

The broad lower part of the Mississippi Valley, from the southern boundary of the glacial drift to Louisiana, contains a very extensive unfossiliferous deposit of sand and gravel, designated formerly from its prevailing ferruginous color as the Orange sand, later called by McGee the Appomattox formation in its development on the costal plain of the Atlantic and Gulf States, but recently named the Lafayette formation, from Lafayette County in northern Mississippi, where it was earliest discriminated by Professor E. W. Hilgard in 1855 and 1856. This formation was spread across the valley plain 50 to 150 miles or more in width along an extent of 600 miles from the mouths of the Missouri and Ohio Rivers to the Gulf of Mexico, during the closing stage of the Tertiary era and the beginning of the Quaternary, to each of which it has been assigned. McGee,[2] Chamberlin[3] and Salisbury,[4] hold that it is probably referable to the Pliocene period; while Spencer,[5] Hilgard,[6] E. A. Smith[7] and others, as it seems to me preferably, have considered it as the earliest of our Pleistocene formations. Its northern continuation beneath the glacial drift is recognized by Salisbury[8] in western Illinois to a distance of a hun-

[2]Am. Journ. of Science, III, Vol. xxxv, February, April, May and June, 1888; Vol. xl, July, 1890. U. S. Geol. Survey, Twelfth An. Rep., for 1890–91, pp. 347–521, with 10 plates, and 45 figures in the text.

[3]Bulletin Geol. Soc. of America, Vol. i, 1890, pp. 469–480. Am. Jour. Sci., III, Vol. xli, May, 1891.

[4]Article last cited. Geol. Survey of Arkansas, An. Rep. for 1889 (published 1891). Vol. ii, "The Geology of Crowley's Ridge," pp. 224–248.

[5]Geol. Survey of Georgia, First An. Rept., for 1890–91, p. 62.

[6]Am. Jour. Sci, II, Vol. xlii, May, 1866; Vol. xlvii, Jan., 1869; Vol. xlviii, Nov. 1869; III. Vol. ii, Dec., 1871; Vol. xliii, May, 1892. Am. Geologist, Vol. viii, Aug., 1891, pp. 129–131.

[7]Am. Jour. Sci., III, Vol. xlvii, April, 1894.

[8]Bulletin Geol. Society of America, Vol. iii, 1892, pp. 183–186.

dred miles northward from the Missouri River and boundary of the drift, and gravels believed by him to be probably of the same formation occur in the Wisconsin and Minnesota driftless area, while northeastward he has observed the Lafayette gravels in the Ohio Valley in southern Indiana about 150 miles from the Mississippi. McGee states that the Lafayette beds attain their maximum thickness, which is 200 feet or more, in the region about the mouth of the Mississippi, and that they vary thence to a thin veneer, the thickness being proportional directly with the volume of neighboring rivers and inversely with the extension inland.

Previous to the maximum advance of the ice-sheet, the Mississippi River and all its large tributaries eroded deep and broad valleys through the Lafayette formation and underlying strata, cutting at New Orleans to a depth at least 760 feet below the present sea level. Along the central valley, from Cairo to the Gulf, this erosion averages probably 200 feet in depth upon a belt 500 miles long, with a width of 50 to 100 miles, excepting isolated plateau remnants of the Lafayette and older beds, of which the largest are Crowley's and Bloomfield ridges, in Arkansas and Missouri. The land during the valley erosion was certainly 760 feet higher than now, but this I think to be only a small fraction of its uplift. From the transportation of northern Archæan pebbles and cobbles of crystalline rocks to the Lafayette beds of the lower Mississippi and of Petite Anse Island, on the Gulf shore, in the direct line of the axis of the Mississippi Valley, Hilgard believes that during the deposition of these beds the valley had a greater descent and stronger currents of its river floods. He suggests that the increased altitude of the interior of the continent needed to give these formerly more powerful currents may have been 4000 to 5000 feet, being sufficient, probably, to bring the cold climate and ice accumulation of the Glacial period.

Marine submergence of the low coastal and Mississippi Valley areas occupied by the Lafayette formation is supposed by McGee and Spencer to have been requisite for the deposition of its sand and gravel beds, but they see that immediately afterward the land was much higher than now, to permit the extensive and deep erosion of that time. A simpler view of the epeirogenic movements, closing the Tertiary era and inaugurating the Quaternary, seems to me to be found in ascribing these beds to deposition on land areas by flooded rivers descending from the Appalachian mountain region and from the Mississippi basin, spreading gravel, sand and loam over the coastal plain and along the great valley during the early part of a time of continental elevation. The land had lain during the long Tertiary periods at lower altitudes, and its surface was largely enveloped by residual clays and by alluvial sand and gravel. With the elevation of the continent, increased rainfall and snowfall and resulting river floods swept away these superficial materials from the higher lands and spread them on the coastal plain and along the Mississippi Valley, where the streams expanded over broad areas with shallow and slackened currents. As the elevation increased, however, the rivers would attain steeper slopes and finally erode much of the deposits which they had previously made. During the culmination of the uplift, which the writer believes to have been the chief cause of the Ice age, Chesapeake and Delaware Bays were excavated and erosion was in progress at a far more rapid rate than with the present low altitude of this region.

The Lafayette formation seems to me more closely related to the Glacial period and the conditions producing the ice-sheets than to the preceding very long Tertiary era, and for the same reasons which have been well stated by Hilgard and Spencer, namely, their dependence alike on the epeirogenic elevation.[9] With the Ice age we should unite this probably

[9]That epeirogenic movements of land elevation caused the accumulation of the Pleistocene ice-sheets, and conversely, that the end of the Glacial period was due to land depression, I have shown in an appendix of Wright's "Ice Age in North America," 1889, pp. 573–595; the Am. Geologist, Vol. vi, pp. 327–339, Dec., 1890; and the Am. Journal of Science, III, Vol. xli, pp. 33–52, Jan., 1891; and same, Vol. xlvi, pp. 114–121, Aug., 1893. This view, which may be called the epeirogenic theory of the causes of the Ice age, has been gradually thought out in America by Dana, LeConte, Hilgard, Wright and others, and in Scotland by Jamieson. Its earliest announcement was in 1855, by Dana in his Presidential Address before this Association (Proc. A. A. A. S., Vol. ix, for 1855, pp. 28, 29; Am. Jour. Sci., II, Vol. xxii, pp. 328, 329, Nov., 1856).

much longer preglacial time of gradual uplift of the continent, and the Postglacial or Recent period in which we live, to form together the three successive parts of the Quaternary era. How long the early part comprising the epeirogenic uplift, represented by the deposition and erosion of the Lafayette formation, may have been, we can only vaguely or perhaps approximately estimate. During the beginning of the uplift its effect would be probably to increase the transportation and deposition of gravel and sand by the rivers many times beyond their present action. The rate of average land erosion now prevailing throughout the drainage area of the Mississippi is supposed by McGee to be competent to supply in about 120,000 years a volume of river gravel, sand, and silt equal to the original Lafayette formation in the Mississippi Valley. With the greater altitude and increasing slopes of the land during the deposition of the Lafayette beds it may have required a third or a sixth of the time here mentioned, that is, some 40,000 or 20,000 years. As the elevation continued, however, rapid fluvial erosion of these deposits and of the underlying strata ensued, which was extended over so long and broad an area of the lower Mississippi Valley, and to such depth, that, even with the high continental elevation of 2000 to 3000 feet, known from submerged valleys off both the Atlantic and Pacific coasts, it must have required a long epoch. Perhaps it may be reasonably estimated twice as long as the time of the deposition, or somewhere between 40,000 and 80,000 years. The Lafayette period thus comprised two parts or epochs, the first characterized by deposition of the formation, the second by its extensive erosion and the culmination of the continental uplift.

The Glacial Period.

Comparison of the work of the glaciers and ice-sheets of the present time with those of Pleistocene time seems to me best accordant with a reference of all our glacial drift to a single continuous period of glaciation, which, though occupying probably 20,000 years or more, was yet brief as compared with the duration of most other recognized geologic periods or epochs. The outflow of the upper part of the Pleistocene ice-sheets probably exceeded the currents of narrow alpine glaciers, but was less than the advance of broad and deep polar glaciers which end in the sea. For the journey of Pleistocene boulders 1000 miles in the ice-sheet, somewhat less than 3000 years would be required if the average of the glacial currents was five feet per day. The amount of the glacial erosion and of the drift, when compared with the erosion by the Muir glacier in Alaska, imply a short rather than a long duration of the Ice age. This conclusion is further affirmed by the continuance of the same species of the marine molluscan faunas from the beginning of the Glacial period to its end and to the present day.

The duration of the Ice age, if there was only one epoch of glaciation, with moderate temporary retreats and readvances of the ice-borders sufficient to allow stratified beds with the remains of animals and plants to be intercalated between accumulations of till, may have comprised only a few tens of thousands of years. On this point Prestwich has well written as follows: "For the reasons before given, I think it possible that the Glacial epoch—that is to say, the epoch of extreme cold—may not have lasted longer than from 15,000 to 25,000 years, and I would for the same reasons limit the time of . . . . the melting away of the ice-sheet to from 8000 to 10,000 years or less."[10]

Very gentle currents of broad river floods in the Missouri and Mississippi Valleys deposited the North American loess, attending the maximum extension of the ice-sheet and accompanying its departure up to the time of formation of the great marginal moraines. The loess thus testifies that previous to the farthest glacial advance the land sank to its present altitude, and probably somewhat lower on the area of the early drift, but not to the sea level. The vast weight of the continental glacier seems to have been the chief or only cause of this subsidence, as was first pointed out by Jamieson for the similar depression of the British Isles and Scandinavia at

[10]Quart. Jour. Geol. Soc., London, Vol. xliii, 1887, pp. 407, 408. Geology Vol. ii, 1888, p. 534.

the time of final melting of the European ice-sheet. The explanation of this continuance of the ice accumulation and advance after the depression of the land began and until the maxima, both of the land subsidence and ice extension, were attained, with a low altitude and even less descent of the lower Mississippi than now, has been well given by LeConte.[11] The subsidence was doubtless slow, even though probably many times faster than the preceding uplift. It may have occupied only 5000 years, being at a yearly rate of a half a foot to one foot; but possibly it was two or three times as long. While the slow sinking of the land was taking place, the accumulation of the ice by snowfall may have proceeded at a somewhat more rapid rate, so that the thickness of the ice-sheet and the altitude of its surface were increasing up to a maximum nearly coincident with that of the subsidence. Finally, however, the subsidence brought a warmer climate on the southern border of the ice, causing it to retreat, and giving to it in the region of the marginal moraines a mainly steeper frontal gradient and more vigorous currents than during its growth and culmination.

The time of general retreat of the ice-sheet in North America, with low altitude of the land and marine submergence of the coastal borders of northeastern New England, northward from Boston, and of the eastern provinces of Canada, with ingress of the sea along the valleys of the St. Lawrence and Ottawa Rivers and the basin of Lake Champlain, has been named by Dana the Champlain epoch. It was the final stage of the Glacial period, and was characterized by the rapid deposition of the glacial and modified drift, whose materials had been contained in the lower part of the ice-sheet.

The Postglacial, Recent, or Present Period.

Closely following the deposition of the modified drift as wide and deep flood-plains in the principal river valleys draining away from the departing ice, these beds were deeply eroded by the streams as soon as the ice-front had so far

[11]Bulletin Geol. Soc. of America, Vol. ii, 1891, pp. 329, 330. Elements of Geology, third edition, 1891, p. 589.

receded that the supplies of water and drift from its melting ceased. Much of the valley drift was soon removed by the river channelling, and its remnants, being left as terraces on the sides of the valleys, caused this first stage of the Postglacial period to be long ago named by Dana the Terrace epoch. In less vigorous action the streams have continued at the same work to the present day, so that this term may be extended also to comprise this whole period.

In various localities we are able to measure the present rate of erosion of gorges below waterfalls, and the length of the postglacial gorge divided by the rate of recession of the falls gives approximately the time since the Ice age. Such measurements of the gorge and falls of St. Anthony by Professor N. H. Winchell, show the length of the Postglacial or Recent period in Minnesota to have been about 8000 years; and from the surveys of Niagara Falls, Mr. G. K. Gilbert estimated it to have been 7000 years, more or less. From the rates of wave-cutting along the sides of Lake Michigan and the consequent accumulation of sand around the south end of the lake, Dr. E. Andrews believes that the land there became uncovered from its ice-sheet not more than 7,500 years ago. Professor G. Frederick Wright obtains a similar result from the rate of filling of kettle-holes among the gravel knolls and ridges called kames and eskers, and likewise from the erosion of valleys by streams tributary to Lake Erie; and Professor Ben. K. Emerson, from the rate of deposition of modified drift in the Connecticut Valley at Northampton, Mass., thinks that the time since the Glacial period cannot exceed 10,000 years. An equally small estimate is also indicated by the studies of Gilbert and Russell for the time since the last great rise of the Pleistocene lakes Bonneville and Lahontan, lying in Utah and Nevada, within the arid Great Basin of interior drainage, which are believed to have been contemporaneous with the great extension of ice-sheets upon the northern part of the North American continent.

Professor James Geikie maintains that the use of paleolithic implements had ceased, and that early man in Europe made neolithic (polished) implements, before the recession of the ice-sheet from Scotland, Denmark and the Scandinavian peninsula; and Prestwich suggests that the dawn of civilization in Egypt, China and India may have been coeval with the glaciation of northwestern Europe. In Wales and Yorkshire the amount of denudation of limestone rocks on which drift boulders lie has been regarded by Mr. D. Mackintosh as proof that a period of not more than 6000 years has elapsed since the boulders were left in their positions. The vertical extent of this denudation, averaging about six inches, is nearly the same with that observed in the southwest part of the Province of Quebec by Sir William Logan and Dr. Robert Bell, where veins of quartz marked with glacial striæ stand out to various heights not exceeding one foot above the weathered surface of the enclosing limestone.

From this wide range of concurrent but independent testimonies, we may accept it as practically demonstrated that the ice-sheets disappeared only 6000 to 10,000 years ago. Within this period are to be comprised the successive stages of man's development of the arts, from the time when his best implements were made of polished stone through the ages of bronze, iron, and finally steel, to the present time when steel, steam and electricity seem to bring all nations into close alliance.

Estimated Duration of the Quaternary Era.

Arranged in chronologic order, we have derived for the three parts of the Quaternary era, as here defined, the following estimates of their duration: the Lafayette period or time of preglacial epeirogenic elevation, with the deposition and erosion of the Lafayette beds, some 60,000 to 120,000 years; the Glacial period, regarded as continuous, without interglacial epochs, attending the culmination of the uplift, but terminating after the subsidence of the glaciated region, 20,000 to 30,000 years; and the Postglacial or Recent period, extending to the present time, 6000 to 10,000 years. In total, the Quaternary era in North America, therefore, has comprised probably about 100,000 or 150,000 years, its latest third or fourth part being the Ice age and subsequent time. The Tertiary era appears by the changes of its molluscan faunas to have been vastly longer, having comprised, perhaps, between two and four million years, of which the Pliocene period would be a sixth or eighth part, thus exceeding the whole of the ensuing era of great epeirogenic movements and resulting glaciation.

Divisions of Quaternary Time.

The following table of the several divisions, periods and epochs of Quaternary time, as reviewed in this paper, is arranged in the descending stratigraphic order of their geologic formations.

Psychozoic division	Recent period	Recent or Present epoch.
		Terrace epoch.
Pleistocene division	Glacial period	Champlain epoch.
		Glacial epoch.
	Lafayette period	Epoch of great elevation and erosion.
		Lafayette epoch.

THE HOMOLOGIES OF THE UREDINEAE (THE RUSTS).

By Charles E. Bessey.

The place of the parasitic plants constituting the Order *Uredineae* (The Rusts), in a natural system of classification, has long been in doubt, botanists not being fully agreed as to the homologies existing between these and other fungi. In a study of this group, extending over many years, I have been led to a view of the homologies between these plants and the Ascomyceteae and Basidiomyceteae, somewhat at variance with the theories of most recent writers; and it is probable that the time has come for a more definite statement of this view than has yet been given.

General Structure.

The *Uredineae* are parasitic within the tissues of higher plants, for the most part Anthophyta. They consist of sepptated branching threads which vegetate for some time within the host, and eventually produce spores (*conidia*) in chains, by abstriction. These spores develop upon numerous, crowded, parallel, terminal branches, within the tissues of the host, at length bursting through the epidermis. The outer conidial branches are modified into a "peridium," which surrounds the erumpent spore-mass like a tiny cup, whence the common name, "Cluster-cup," in allusion also to the fact that the spore-cups usually appear upon the leaf in clusters. For a long time these cluster-cups were supposed to have no connection with the rusts, and they accordingly were described under the generic names *Aecidium* and *Roestelia*. The first of these names is preserved in the term "aecidiospore," by which the spores are often designated. (Figs. I and II of Plate XXXII.)

Somewhat later, spores of another kind are produced singly upon the ends of other branches in the tissues of the host. These, while occurring in clusters, are by no means as closely and regularly crowded as the aecidiospores, so that when they burst through the epidermis of the host they constitute elongated or irregular shaped spore-dots (*sori*) instead of definitely outlined cups. Here again, the spores of this kind were regarded by the earlier botanists as belonging to a distinct genus, *Uredo*: hence we commonly still speak of them as *uredospores*. They are also known as "stylospores," in allusion to the fact that they are stalked. (Figs. III and IV of Plate XXXII.)

Still later, a third kind of spore is produced, often in the uredosori, which bear some resemblance to the uredospores in being stalked, and in some cases, one-celled (*Uromyces, Melampsora*), but differing often in being two or more celled, and usually having a thicker wall. These are the last to develop upon the mycelium within the host, and when they have ripened, usually the parasite dies. Since these spores appear to complete the development of the parasite, they have long been known as teleutospores (τελευτή, "completion.") They germinate (in many species after a period of rest through the winter months) by the production of a short, several-jointed filament (the *promycelium*), from each cell of which short lateral branches develop, upon whose summits single minute spores (sporidia) are formed by abstriction. When these sporidia germinate upon the proper host they form parasitic threads which penetrate its tissues and give rise to the aecidia described above, thus completing the cycle of life. (Figs. V to XIII of Plate XXXII.)

The life history here sketched may be taken as typical, but it is subject to several modifications, e. g., (*a*) the omission of the aecidial stage; (*b*) the omission of the uredo stage; (*c*) the omission of both the aecidial and the uredo stages. Moreover, in many species the aecidial stage occurs upon a different host from that which supports the uredo and teleutospore stages, this condition being known as heteroecism, a familiar example of which may be seen in one of the common rusts of wheat (*Puccinia graminis*), where the aecidiospores develop on the leaves of the Barberry (*Berberis vulgaris*), the uredospores and teleutospores alone occurring in the leaves and stems of the wheat. In many heteroecismal species it has hitherto been found impossible to determine the aecidium belonging to it, and for many aecidia occurring upon common plants, the uredo and teleutospore stages are not known. The difficulties surrounding this problem are so great as to discourage the attempt to solve them.

Homology of Parts.

Having now a general idea of the structure of the *Uredineae,* we come to the important question of the homology of their parts. Here, again, we are beset with difficulties. No sexual organs have yet been discovered, and there has been very much structural degeneration of the whole plant.

In their general structure the Uredineae show clearly that their relationship is with the *Ascomyceteae* or *Basidiomyceteae* rather than with the *Phycomyceteae,* and upon this point there has been little disagreement among recent botanists. Some authors regard the aecidium as a kind of degenerated apothecium, in which each conidial chain is a modified ascus. In this view, the aecidium is the result of an obsolete or obsolescent sexual act, as in the *Discomyceteae,* and the uredospores and teleutospores are considered to be conidial structures. Accordingly, those who hold this view quite consistently set off the *Uredineae* in a class bearing the name *Aecidiomycetes.* By far the greater number of botanists, however, now regard the teleutospores as basidia, homologous with the basidia of the *Hymenomyceteae* and *Gasteromyceteae,* and they therefore place the *Uredineae* in the class *Basidiomyceteae.* In this view, the sporidia which develop upon the germination of the teleutospore are basidiospores, homologous with those of mushrooms and puff balls, and the uredospores and aecidiospores are forms of conidia. It is needless in this paper to set forth these views at length, since they may be found in almost any common text-book of botany.

Briefly stated, the view which I wish to present is that the "teleutospore," so-called, is a tightly fitting ascus, containing one or more large spores; the teleutosorus is a reduced apothecium; the aecidiospores are the normal conidia; and the uredospores secondary or accessory conidia (stylospores). In many cases the ascus-wall is readily separable from the contained spore or spores; but for the most part, the ascus-wall is so closely adherent as not to be distinguished from the spore-wall without treatment by potassic hydrate or other reagents.

In one genus, *Uropyxis*, the ascus is much larger than the double spore it contains, and may be observed very easily without special preparation. (Fig. VIII of Plate XXXII.) In *Gymnosporangium* in fresh material an ascus cavity considerably larger than the double spore can be seen in carefully made preparations. Young "teleutospores" of *Phragmidium*, in which the spores have not yet attained full size, show the ascus-wall very clearly, (Fig. IX of Plate XXXII), although in mature specimens by the enlargement of the spores it can be seen with difficulty, if at all. By careful examination, one may make out the ascus-wall in a good many cases where otherwise it might be overlooked. I have little difficulty in distinguishing it in some species of *Uromyces* (where the ascus contains but one spore) and *Puccinia* (where the ascus contains one double spore, or more accurately speaking, two spores), especially after the application of strong potassic hydrate.

The Question of Relationship.

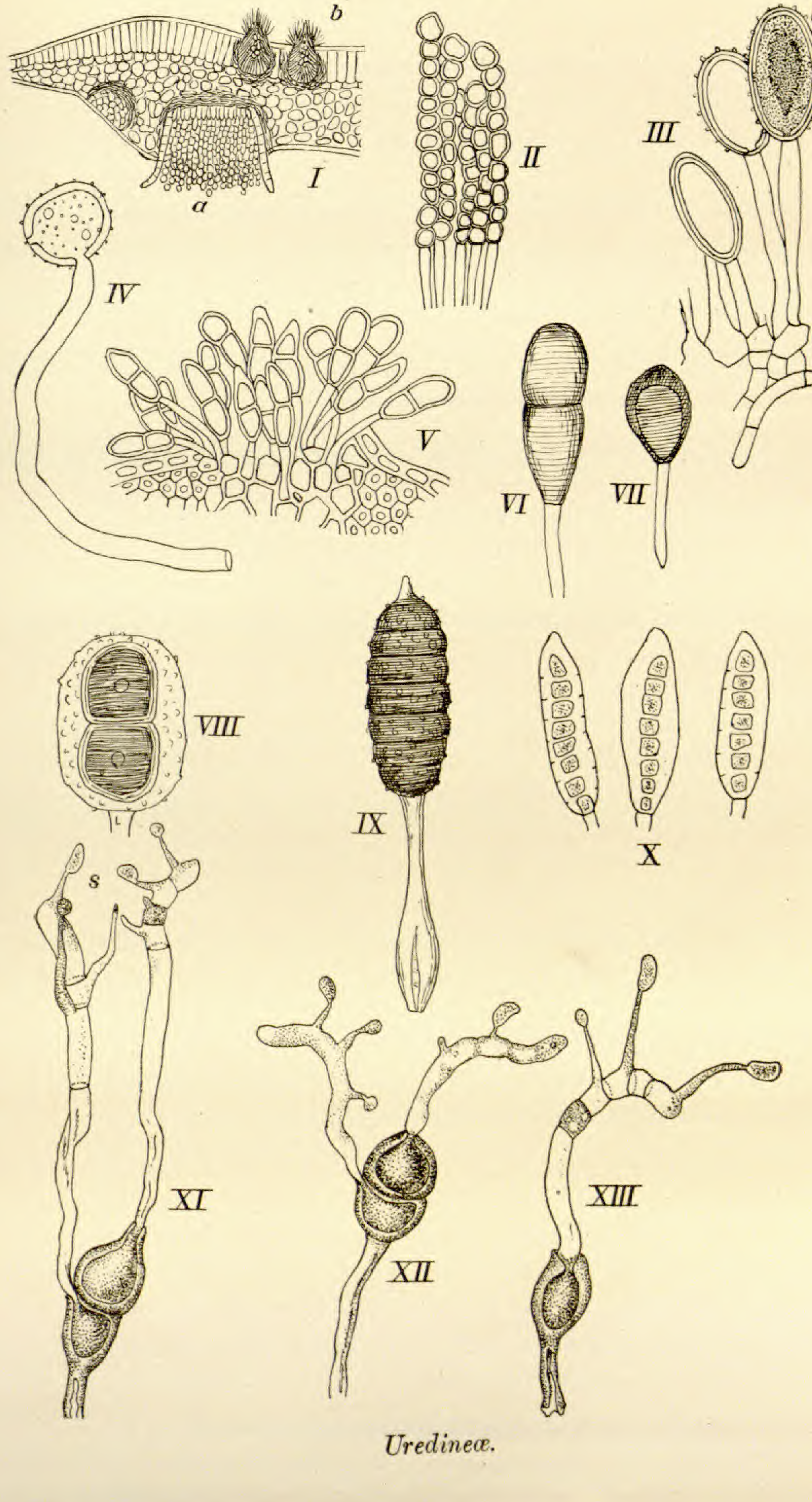
The view here set forth, that the so-called "teleutospore" is an ascus with its contained spore or spores, involves the supposition that the *Uredineae* have suffered much structural degeneration. When we consider the fact that they are, as we may say, *intensely* parasitic, there is no improbability that we are dealing here with a greatly reduced plant structure. One has but to contrast a Dodder with a Morning Glory, or a Broom-Rape (*Aphyllon*) with a Figwort (*Scrophulariaceae*) in order to realize what great changes are produced by a parasitic habit. It has long been well known in biology that the greater the parasitism of an organism the greater is its degeneration. Some plants take but little from their hosts, and still maintain their roots, stems and leaves with so little change that it is scarcely perceptible. It is said that some of the Gerardias are parasitic, and yet who can perceive in the countenance of any of our species any evidence of this particular vegetable sin? The closely related painted cups (*Castilleia*), however, give evidence in their appearance that their habits are not what they should be. It is even more so with *Comandra*, while the Mistletoe bears the marks of degradation upon every organ. It is not otherwise with the Carpophytes. When some ancestral seaweeds became saprophytic and parasitic, that structural degeneration of parts began which gave us the many kinds of fungi. No one may now trace with certainty the genetic line of the fungi, but that they originated from holophytic ancestors cannot be doubted; nor can there be reasonable doubt that they have become structurally more and more modified the further they have departed from holophytic habits. The holophyte requires masses of chlorophyll-bearing cells, or as we commonly express it, its vegetative organs must be well developed, but the hysterophyte has no use for such tissue, and consequently, its vegetative organs are undeveloped. The more perfectly the parasite adapts itself to its host the greater may be its departure from the structure of its vegetative organs which its holophytic ancestors developed. In like manner, the more perfectly the parasite merges itself into its host, and in a sense becomes a part of it, the more may it use the host tissues for protection and support, and the less is it necessary for it to develop protective tissues of its own. Thus we have in the fungi not only a degeneration of the vegetative tissues, but the reproductive organs have likewise undergone much degenerative modification.

We here regard the *Uredineae* as degenerated Cup-Fungi (*Discomyceteae*), with their cups (apothecia) obsolescent, and constituting the vaguely defined teleutosori. As suggested above, there is here no need of that abundant accessory tissue which in the Cup-Fungi forms a protective envelope (exciple) around the hymenial mass, since the asci ("teleutospores") develop beneath the protecting epidermis of the host. The host-tissues in the case of the *Uredineae*, act the part of the exciple in the normal cup-fungi. The apothecia of the cup-fungi are therefore homologous with the "sori" of the teleutospore stage of the *Uredineae.* Instead of the large eight spored asci, which are so common in the *Discomyceteae,* we find in the *Uredineae* that they are much reduced, both in size and the number of spores which they contain, there being rarely more than one or two. And here we may propose, in the light of the view here adopted, that the term "teleutospore," while a misnomer as usually applied, be retained with a restricted application to the spore or spores within the ascus. Thus we may say that the ascus of *Uromyces* contains but one teleutospore, while in *Phragmidium* it contains several. If necessary (which I doubt) to distinguish these reduced asci from normal ones, we may employ the convenient term *teleutoasci.* We may thus have *teleutosorus, teleutoascus* and *teleutospore.*

Place in the System of Plants.

It remains to say a few words as to the place in the system of plants to be assigned to the *Uredineae* in accordance with these views. From what has been said, it follows that they are to be regarded as *Ascomyceteae,* instead of *Basidiomyceteae,* as so many recent botanists assert. Further, it is held that they are degraded and much modified forms standing at or near the end of a long genetic line, and not primitive or ancestral forms from which higher and more complex ones have sprung. The cup-fungi have not been derived from the *Uredineae,* but rather we may say that, in all probability, the latter have been derived by degeneration from the former. We must, therefore, assign the *Uredineae* to a place in the *Ascomyceteae, after* the *Dicomyceteae.* All may well agree to assign the *Perisporiaceae* to the first (or lowest) place in the class on account of their slight modification from the type of the holophytic Carpophytes. From this primitive group we pass easily along three somewhat divergent genetic lines, viz.: the *Tuberoideae, Pyrenomyceteae,* and *Discomyceteae,* and from the latter have sprung the *Uredineae.* The arrangement will then be as follows:

PLATE XXXII.



Uredineæ.

CLASS ASCOMYCETEAE.

Order *Perisporiaceae*,
Order *Tuberoideae*,
Order *Pyrenomyceteae*,
Order *Discomyceteae*,
Order *Uredineae*,
Order *Ustilagineae*.

CLASS BASIDIOMYCETEAE.

Order *Gasteromyceteae*,
Order *Hymenomyceteae*.

Of the relationship of the *Uredineae* to the *Ustilagineae* I need say no more at the present time than that the latter are here regarded as still further degradations of the *Discomyceteae*; nor is this the place in which to take up a discussion of the homologies between the *Ascomyceteae* and the *Basidiomyceteae*. Upon the latter point it is sufficient to say that the ascus and the basidium are regarded as morphologically equivalent, the ascus subdiving its protoplasmic contents into spores by an internal division (forming ascospores) while the basidium accomplishes the same thing by the growth of protrusions ("sterigmata") into whose enlarged ends the protoplasm passes, after which they separate as spores (basidiospores).

EXPLANATION OF PLATE XXXII.

I. Cross section of a Barberry leaf; *a*, a cup of aecidiospores; *b*, spermogones of *Puccinia graminis*, after Luerssen × 40.

II. Rows of aecidiospores (conidia) of *P. graminis* upon their conidiophores, after De Bary × 150.

III. Uredospores of *P. graminis*, the shaded one ripe, after De Bary, × 390.

IV. Germinating uredospore of *P. straminis*, after De Bary, × 390.

V. Cross section of a teleutosorus of *P. graminis*, after De Bary, × 200.

VI. Teleutoascus of *P. graminis,* external view, after Ludwig, × 450.

VII. Teleutoascus of *Uromyces fabae,* optical section, after Ludwig, × 450.

VIII. Teleutoascus of *Uropyxis amorphæ,* optical section, after Ludwig, × 450.

IX. Teleutoascus of *Phragmidium subcorticium,* external view, after Ludwig, × 450.

X. Immature teleutoasci of *Phragmidium subcorticium,* after Bessey, × 400.

XI. Germinating teleutospores (still within the ascus) of *Puccinia graminis; s.* sporidia, after Tulasne, × 400.

XII. Germinating teleutospores (still within the ascus) of *Puccinia moliniae,* after Tulasne, × 400.

XIII. Germinating teleutospore (within its ascus) of *Uromyces appendiculatus,* after Tulasne, × 400.

ON THE EVOLUTION OF THE ART OF WORKING IN STONE. A PRELIMINARY PAPER BY J. D. McGUIRE.

A Reply by Charles H. Read.

In the *American Anthropologist* for July, 1893, appeared an essay with the above title. The writer, with whom I am personally unacquainted, was good enough to send me a separate copy of it. I read it with some interest, for the efforts of an earnest worker, who attempts, by novel methods, to solve a difficult problem, cannot fail to be of interest to any one who has given attention to the problem itself.

The question of palæolithic man in America has, moreover, given rise to such fierce discussion that it seemed necessary to point out the danger that lies in the use of improper or irrelevant evidence. Such methods can only serve to mislead enquirers and to delay the solution of the puzzle. The paper now in question is so persistent in its pursuit of will-o'-the-wisps that a better text could scarcely be found.

The problem Mr. McGuire has set himself to resolve, stripped of all redundant matter, is this: whether the so-called palæolithic remains of Europe are necessarily older than the so-called neolithic? Incidentally he implies that "from a purely archæological standpoint, the paleoliths of Europe and the similar American implements are in all particulars, identical, and are productions of man existing under like conditions." What he understands by an archæological standpoint we shall see later, but first I would deal with the main contention.

Noscitur a socii is an axiom of archæology. When an object is found in the earth, and is dumb as to its own history, we naturally and justly turn to its companions to help us. This is good so far as it goes, and in an isolated case we may go wrong. But when we multiply the single case with fifty or a hundred, finding in all the same association of objects, and the circumstances attested by persons of known observation and probity, what before was probability is turned into as great certainty as humanity can attain over the past. This, in a few words, is the foundation upon which paleolithic man in Europe now stands. This foundation might be broadened by much geological addition, but the argument would be none the more forcible. To put it more directly, certain flint implements are found in a stratum of a known age, so that this particular stratum comes to be recognized by all observers as their habitat. They are found elsewhere, truly, but when so found they usually bear indications of the vicissitudes they have undergone since leaving their home. Such flint implements, further, are found associated with the remains of animals which are universally admitted to belong to a given geological epoch. Here again they are so associated with such persistency, noted by such widely separated and independent observers, that the possibility of universal error is as wildly improbable as that of universal conspiracy. Such being the class of evidence upon which the antiquity of palæolithic man is founded, it is obvious that any attack, to be effectual, must be made on the premises. If it could be shown either that the palæolithic implements were not found in their undisturbed bed, or that the animal remains near them had no connection with them, then any conclusions based upon such association would necessarily fall to the ground.

Mr. McGuire takes, however, an entirely different stand. His theories are based upon his own experience as an amateur maker of stone implements, and his experiments have led him to the belief that it is *far easier* to make a polished stone implement than a chipped one, and that *therefore* polished *flint* implements are at least as old as those that are only chipped and not polished!

Has Mr. McGuire ever seen a specimen of Kafir or Polynesian carpentry? In the British Museum is a Kafir copy of a common European chair, made in the usual fashion as to shape, with slender spars for a back, a solid seat and spidery legs. This is cut from one solid block of wood, surely a far more difficult task than to make the chair by joining in the usual manner. Applying Mr. McGuire's argument to this case, and it does not seem an unfair application, for both the

Kafir and the Polynesian cuts everything from the solid, where does it land us? Are we to think that they began with joining, without doubt the easier method, and finally came to the more difficult, the cutting from the solid? Surely not; the natural explanation is the best, simply that the easier method of work did not occur to them.

From another point of view Mr. McGuire's experience is somewhat at variance with that of others. Palæolithic implements in Europe, and I would prefer to speak of Europe only at present, are made of very few materials, chiefly flint and quartzite. Mr. McGuire knows and admits this fact, but seems to assert that it is easier to form an implement by battering than by chipping. If the implement is to be of flint, I greatly doubt it, but if of certain stones of difficult or uncertain fracture, it may well be the case.[1] It seems inconceivable that such a statement could be calmly made, seeing how entirely contrary it is not only to the experience of all who have tried the experiment, with the single exception of Mr. McGuire, but also in direct opposition to all the evidence on the subject. Can Mr. McGuire point out a single instance of a polished implement being found on an admitted palæolithic site? He gives no such instance, and as it would form the strongest point in his whole argument if he could quote one, we may presume that he does not. That being so, surely it is fighting the air to bring a long array of his own experiments to prove that palæolithic man *ought* to have found out what he considers the easiest way of making his tools.

It may be well to make the point at issue quite clear by stating that there is no question of the polishing or grinding of an implement caused *by use.* Such an instance, probably more than one, of the chipped edge of a tool of palæolithic age being worn or ground by applying it to its destined work, has occurred. But it has never been urged that the effect thus produced was part of the original design.

Before leaving this branch of the enquiry I would fain quote Mr. McGuire's peroration. He says that palaeolithic man

[1] I say "seems to assert," for though the point at issue is the making of palaeolithic implements, yet Mr. McGuire uses the indefinite term "stone" when he should say "flint."

"had knives with which he could cut various articles and needles with which to sew; he knew the art of making and burning pottery; could and did make fire; he drilled holes of large and small size in bones, antlers, shells and fossils, and was familiar with the art of engraving at a period contemporaneous with the Mousterian implement and a quaternary fauna. With such evidence can it be argued that man was ignorant of a knowledge of the process by which stone was battered and ground in to shape and yet familiar with the more complicated art of chipping?"

On the other side I would put the man of the eighteenth century. He was familiar with the learning of two thousand years preceding his own time; he knew and practised the art of printing; he was an accomplished chemist and astronomer; he was an admirable artist in painting, sculpture and music; was a student of the forces of nature; traversed the whole world for the improvement of his mind or the bettering of his fortunes; he was expert in the beautifying of his every day surroundings, of furniture and the accessories of a luxurious home. With such evidences should it not be argued with far greater force that he must have known that under the lid of his boiling tea-kettle, a utensil of daily use, lay a force that would carry him over land or sea five times more swiftly than the swiftest horse? Yet it is remarkable that he never thought of the application of the power of steam.

One word about the "purely archæological standpoint." This seems, in Mr. McGuire's view, to resolve itself into "the character and size of the chips detached appearing identical as do the so-called implements when laid one beside the other;" for, on the same page, he says, "Taking the type of the implement as a criterion of antiquity, America, Europe and Asia stand on the same footing." This, however, is the most dangerous criterion that could be taken. Even in Europe where the material used and the character of the sites are nearly alike, the type of implement alone is by no means a certain indication of age. I have seen hundreds of undoubted neolithic implements of far ruder work than an ordinary implement from the drift. And there is every reason why it should be so. The material used is the same, and we have no ground for supposing that the process of manufacture was different. When, however, the types of one Continent are used as a criterion, by superficial resemblance alone, for determining the date of similar implements from another and distant Continent, the conclusions arrived at can obviously be of no value whatever.

I have long thought that a prominence totally undeserved has been given to the rule of thumb distribution that "chipped — polished = palaeolithic, and chipped + polished = neolithic." Its only virtue is its convenience and that it is easy to remember. But to exalt it to the dignity of a determinative factor is, I think, a great mistake, and I feel sure that many ardent collectors of stone implements cling to this accidental distinction as their sheet-anchor for data. The fact that palæolithic man overlooked the polishing of his implements is a mere accident, a subsidiary and incidental peculiarity, and possesses no right whatever to the importance it has attained. It has not the least value in determining whether an implement is of one or the other period. The converse of the proposition does not, of course, hold good in our present state of knowledge. If a polished implement of flint be found, it can safely be declared non-palæolithic, for the reason that up to now no implement with a designedly ground surface has been found on a palæolithic site. It would be of the greatest service in this particular if some fortunate searcher could light upon a hoard of polished palæolithic flint tools. Then it is possible that the true determination of palæolithic as opposed to neolithic would obtain proper recognition; that it does not rest upon the slender evidence of "chipping only," but upon a far more solid foundation, to wit, the evidence of the bed in which it lies.

To the observer in Europe the whole question of what is known as palæolithic man in America seems to be in a chaotic state. There appear to be many reasons for this. One principal one is, without doubt, the unfortunate reliance upon a particular type of implement as a distinguishing character of palæolithic deposits. Granted that such a type has a determinative value in Europe, by what process of reasoning can it be argued that man, living thousands of miles away, has produced the same peculiar variety, simply because he lived with a similar group of extinct animals? Another reason, perhaps equally potent, is that only a very limited number of the students of early man in America have made any lengthened study on the spot of the conditions under which these remains are found in Europe. If the conditions are to be similar in America, then this would appear to be a necessity. If they are unlike, as is very possible, yet there must be sundry points of resemblance, and it is surely of value to proceed to the study of the unknown by familiarizing the mind with the date of a known and accepted condition. To sum up in a few words—let intelligent observers, trained to use their eyes, knowing what constitutes evidence, and capable of recording it, let such men work over the possible sites of the American Continent, and the result of their labors will, without any doubt, be of the greatest value to science, whether palæolithic man be found or not. But it is of the first importance that the explorers be trained men. The investigations of men without the necessary knowledge not only causes the results to be of little present value, but their work destroys the very evidence upon which alone true knowledge can be founded.

ZOOLOGY IN THE HIGH SCHOOL.[1]

BY CLARENCE M. WEED.

I do not see how the program recommended by the Natural History Conference of the Committee of Ten[2] can escape the charge of being inadequate and one-sided. According to it, eight years of study of at least two periods each week are to be devoted to plants before the high school is reached. This study includes not only the various parts and functions of the higher plants, their classification and life-histories, but the lower plants as well. Then in the high school five exercises a week for one school year are to be devoted to what can be considered only as a systematic review of knowledge already acquired. In all the twelve years of school life no provision is made for the study of animals, except a brief term of physiology, unless the advice of the conference is ignored and zoology is substituted for botany in the high school course. Truly it would appear that the much abused term—natural history—is to be restricted once more and become a synonym of botany. That the Conference did not intend to restrict the nature study of the lower schools to plants is abundantly shown by their answers to the questions submitted by the Committee of Ten, in which they distinctly recommend the study of both plants and animals for these grades.

The Conference "agreed that the year of study in natural history, recommended as a minimum for the high school, should be a consecutive year of daily recitations or laboratory work, and it is better to have the year's work devoted to one subject, either botany or zoology, than to have it divided between the two." Two years have passed since this opinion was promulgated, and while it may have represented the best educational ideas concerning the study of biology then, there

[1] From a paper read before a High School Teachers' Institute, Concord, N. H., Sept. 21, 1894.

[2] Rept. of Committe on Secondary School Studies, pp. 138–158., U. S. Bereau of Education.

is abundant evidence to show that it does not to-day. For there are many indications that biological teachers are accepting and adopting the dictum long since enunciated by Huxley that "the study of living bodies is really one discipline, which is divided into zoology and botany simply as a matter of convenience." Nothing shows this more clearly than the general adoption of such books as Huxley & Martin's Course of Elementary Instruction in Practical Biology, Parker's Lessons in Elementary Biology, Dodge's Introduction to Elementary Practical Biology, and Boyer's Laboratory Manual in Elementary Biology. These books are designed for use in the high schools and colleges, and unquestionably represent the consensus of opinion among the most successful biological teachers. They show that the study of living things can easily be carried on in a consecutive course in which the student may obtain a basis of sound biological knowledge concerning the organisms on both sides of the imaginary fence which separates the plant and animal world. I doubt if any fair-minded zoologist would think of insisting on confining the biological training of high school students to animals, for it would be a one-sided and inadequate training introducing the pupil to one phase of nature when he is entitled to an introduction to both. No more should the botanist claim an exclusive privilege in this respect.

The reasons given by the Conference report for choosing botany instead of zoology are three, viz.: (1) "Because the materials for the study of that subject are probably more easily obtained than those for the study of zoology; (2) Because the study of plants is more attractive to the average pupil; and (3) Because, in the study of animals, many prejudices or aversions have to be overcome." Obviously, these last two causes should be considered as one, the explanation of the greater attractiveness of plants must largely be found in the prejudices and aversions to animals. My own experience in teaching both subjects leads to the opinion that there is little weight to be given the argument on either side: some students prefer one subject and some the other, but the greatest enthusiasm is always aroused by the study of animals like Vorticella, whose life processes are watched in the field of the microscope. As to the first reason, the probable greater ease of procuring botanical material, the probability was not justified by the recent experience of Mr. C. H. Clark and myself at the New Hampshire College Summer School of Biology. We there went over, with nearly twenty teacher-students, the work in botany and zoology recommended in the programs of the Natural History Conference Committee, the afternoon sessions being devoted to botanical instruction by Mr. Clark, and the morning sessions to zoological instruction by myself. We both spent much of our spare time foraging for supplies, but I think Mr. Clark had the more difficult task of the two. Evidently these reasons are open to question, and, in any event, as mere reasons of expediency, they should give way to the larger considerations involved in other phases of the subject.

The limits of time forbid present discussion of the many claims of biology as a whole upon modern education, but I may say in passing that one of the most important of these claims is to be found in the relations of biological science to the philosophical problems of the day. Our philosophy is so permeated with the evolutionary phraseology that a knowledge of biological terms and processes is essential to the daily reading of an intelligent man. Such knowledge cannot be adequately obtained from the study of either plants or animals alone.

I believe that the position of a large proportion of biological teachers in America concerning biology in the high schools may fairly be represented by the following propositions: (1) That biology should be taught rather than either botany or zoology alone; (2) That the course should cover two years of at least three periods a week if possible, if not, that it cover as much time as can be spared to it, the minimum being one year; (3) That in general the time should be about equally divided between animals and plants, and that the study of the latter should come first, although some simple animal cells may well be studied at the start in connection with the lowest plants; (4) That the instruction should be given by means of the laboratory method of individual study of organic types, beginning with the lower forms and proceeding upward in the scale of life; (5) That the methods employed should aim to develop the faculties of the student as well as to add to his store of knowledge—should be educative as well as instructive; and (6) That the laboratory work should be supplemented to as great an extent as possible by field excursions and outside reading.

It is scarcely necessary at this time to emphasize the importance of the laboratory method of studying biology. It is the only possible way; and if it cannot be adopted the boys had better be turned out in the woods to study nature first hand there. They will thus gain more useful knowledge and experience than they possibly could from the old-fashion textbook of zoology in which the student was introduced through a dead language to a much deader world. The equipment of a biological laboratory need not be very expensive. The essential furniture will consist of low simply-constructed tables with accompanying chairs, shelf-room and window-space. Each student should be provided with a compound microscope which can be purchased for $17.00, and a few simple accessories. Glass jars of some form—nests of beakers of larger sizes are excellent—should be provided for aquaria, and some simple reagents and dissecting dishes are necessary.

The logical method of commencing the study of zoology unquestionably is to study the lowest forms first and proceed in natural sequence to the higher ones. The student thus acquires a philosophic view of the animal kingdom and of the method of its development. He studies first the cell in the manifold modifications which it assumes in the one-celled animals; then he sees cells remaining connected superficially to form the simplest metazoa, and finally studies their myriad combinations in the higher animals. He proceeds from the simple to the complex—studies the materials of construction before studying the completed structure. The chief objection that has been raised to this method is that the student is required to begin the subject with high powers of the microscope—an instrument with which he may not be familiar—and that by means of it he is suddenly introduced to new and strange forms of life. This objection has been urged with force by the master-teacher of modern biology, Professor Huxley, who, in the revised edition of his Course in Practical Biology, begins with the frog and works downward. That the experience of American teachers does not lead them to attach so much importance to the objection is shown by the fact that all of the authors of our best laboratory manuals—such as those of Dodge, Bumpus, Brooks and Boyer—have adopted the method of proceeding from below upward, and I think the practice of a majority of biological teachers points in the same direction. Possibly the aptness of American boys and girls in mastering such details as those of microscopic technique may account for the difference in the practice.

A serious objection to beginning the study of zoology with the frog or any higher animal is that it involves putting the student to the work of dissection before his interest is aroused. To many boys and more girls this is sufficient to give them a dislike to the whole subject. But if they first study living animals by watching their movements beneath the microscope, their interest can be so aroused that they can be led to simple dissections without difficulty. Many of them, indeed, will be so charmed with the work that they will echo the sentiment of the young lady at a leading New England college who is credited the enthusiastic remark that "Earthworms are perfectly lovely, especially the inside."

The teacher should adopt one of the newer laboratory guides, selecting the one that seems best adapted to the needs of the class and the time to be given to the subject, and having devoted a preliminary exercise to the use of the microscope, should start the students in individual studies of the types treated of in the guide. Abundance of material should be provided, and the students should be taught to rely upon their own resources to as great an extent as possible. At first they will need constant assistance, but later they will become more independent. Drawings and full notes are to be required.

An important part of the educational value of a laboratory course in biology depends on the requirements as to the student's notes. If one adopts the somewhat common practice of allowing the student to follow the laboratory guide in his note-book, often answering questions by number with a yes or no, the results will be far from satisfactory. In my own classes I have adopted the method of writing upon the blackboard a definite subject, *e. g.*, "A Description of the Structure and Biology of the Amoeba," upon which I require an original essay embodying the results of the student's observations, and such additional explanations as I have given the class at the time the animal was studied. These essays are written upon one side of the letter size paper that goes between clip binders. The drawings are incorporated in the proper places with explanations beneath, the aim being to make all as clear and concise as it should be in a book. These essays are submitted once a week, and if not satisfactory are rewritten. I hope soon to arrange a coöperation with the English department so that the essays may count as English exercises and be reviewed from the rhetorical point of view. Very decided progress has resulted from this method which seems to me the most desirable mode of note-keeping in such laboratory work.

But the ordinary laboratory manual by no means includes all of the "pedagogical contents of zoology." In general it confessedly covers with fair completeness only the morphological side of the subject and leaves almost or quite untouched important phases of the science which should never be ignored. To guide a student along the morphological road is unquestionably the safest and surest way of leading him to a sound basis of biological knowledge, but every opportunity should be taken to point out to him the objects of fascinating interest that are found beside the way. Failure to do this leads to the production of those near-sighted naturalists, who, in the expressive words of Professor Forbes, " must have nature boiled in corrosive sublimate solution and fried in paraffine and sliced by a microtome before they care for it." These are not the nature students the high schools wish to produce. Broadness, not narrowness, is here the aim; and the results in this respect will depend largely on the culture, enthusiasm and preparation of the teacher.

The most important general result to be taught in connection with morphology is that of physiology. So far as possible the study of function should coincide with the study of form. To a considerable extent the newer laboratory manuals provide for this, especially in the lower groups of animals. Emphasis should be laid upon this side of the subject, and explanations be reiterated until the student masters each detail. In the same connection—and here is one of the most important phases of zoology—the teacher should develop those laws of life which give to biology its greatest interest, such as the law of the physiological division of labor and of structural progress from simple to complex; the relation of the one-celled animal to the multicellular one; the similarity of individual development to that of the group; the significance of the nucleus; the phases of reproduction; the facts of biogenesis and abiogenesis, of homogenesis and heterogenesis; the relations of parasitism to degeneration; the differences between plants and animals; the infinity of variations; the main facts of mimicry and protective resemblance; the effects of heredity and environment; the elements of natural selection, and an outline of the theory of organic evolution.

Perhaps you think this is laying too great a burden upon the teacher: it need not, for he may find an admirable, though concise discussion of these principles in Parker's Elementary Biology, and a more elaborate account of many of them in Lloyd Morgan's Animal Life. He should also have at hand for familiar reference Wallace's Darwinism, Poulton's Colors of Animals, Beddard's Animal Coloration, Rolleston's Forms of Animal Life, the Standard Natural History, the important zoological text-books, and as many other similar works as possible.

Perhaps the next most essential feature of the zoological course is a knowledge of the main outlines of animal classification. Not many years ago zoology was taught as if it consisted only of classification, and the inevitable reaction has gone so far that at present there is a tendency to ignore it altogether. This, however, is to be deplored. Classification is an essential feature of the science and should receive due consideration. Here the safest guide for the American teacher is the Standard Natural History which should be in every school library as a work of reference.

Much can be done in arousing the student's interest by means of field excursions and outside reading. These excursions should be taken as frequently as they conveniently can be, and be under the personal supervision of the instructor. Inland schools should plan, if possible, at least one trip to the seaside, choosing a time when the tide will be out during the visit, where crabs, sponges, starfishes, sea-urchins and anemones may be studied as well as sea-lettuce, rock-weeds and many other forms of plant and animal life.

The amount of collateral reading that may be done will vary with the conditions of the school and the interests of the individual student. Biology opens to one an enormous field of literature of fascinating interest in which the teacher should always be browsing; and if wise he will lead his flocks to the feet of the master-minds who have ever found joy and inspiration in the green pastures and beside the still waters, where dear old Mother Nature is always ready to receive our worship and breathe a benediction upon our holiest aspirations.

New Hampshire College, September, 1894.

EDITORIALS.

—The International Geological Congress met at Zurich, commencing on August 29th, and continuing until September 1st, inclusive. On the third of September the Congress started on an extended excursion through the Alps for examination of the geological features en route. Numerous important papers were read, but no official expression as to rules or modes of proceedure in geology were issued or discussed. The most important proposition in this direction had reference to the organization of the congress itself. Dr. Fraser of this city offered the following resolution, "with reference to the organization of the next congress." "(1) To what extent does the Congress recognize the right of Government bureaus as such, or of societies, or any other organization, to send delegates to the congress? (2) Within what limits does the Congress recognize the right of these representatives, or of a part only of the members of the Congress which come from the same country, to designate the Vice-President representing their country, or to act without coöperation with their compatriots in the Congress.?"

This resolution was rendered necessary by the arbitrary action of the president Prof. Renevier, in electing as Vice-President representing the United States, a person who was not present, but who had been recommended for the place by letter. The person so elected is a member of U. S. Geological Survey, and although this fact could not debar him from the position, his appointment under such circumstances brought into prominence the question as to the relative claims of various bodies to appointment to the official positions in the Congress. Since the Committee which originally represented the United States was driven out of existence, owing to the contributive neglect of some of its members, this country has no official representation in the Congress. Hence the propriety of the resolution offered by Dr. Fraser. An easy solution of the question would appear to be suggested by the language of the resolution. That is that the members in attendance from a given country, should get together in advance, and nominate their candidates for presentation to the congress.

—It is proposed by the Filson Club of Louisville, Kentucky, to publish a work on the life and writings of Constantine Samuel Rafinesque by the well known zoologist, Dr. R. Ellsworth Call. An extract from the preface says:

"This memoir had its inception in an attempt to clear up certain matters connected with the synonymy of a large and important group of fresh-water mollusks—the Unionidæ. A number of very remarkable facts connected with the personality of its subject were thus incidentally learned. As the collation of data proceeded, the facts learned seemed of sufficient importance to group them for presentation to the literary and scientific world in the hope that a better and more intelligent understanding of the work of this eccentric naturalist might result. A number of impressions were forced upon my attention as the work proceeded; among other conclusions reached, was the one that Rafinesque had not been always fairly treated by his cotemporaries. Resulting from this was the conviction that many naturalists now living have formed opinions concerning the nature and value of Rafinesque's work which appear to me to be quite erroneous. In the hope that some of these misapprehensions might be corrected, the task of writing his life, which is quite a labor of love, was undertaken."

The prospectus goes on to say "the publication will be in the sumptuous quarto form adopted by the Filson Club, and issued in paper only. It will contain several full page illustrations, one of which will be a portrait of its subject. A complete bibliography of the writings of Rafinesque on every subject, comprising over four hundred titles, will be included, together with a certified copy of his will, one of the most remarkable testamentary documents ever probated," etc.

The gentlemen engaged in this enterprise probably think that they are conferring a benefit on contemporary and future science by issuing this publication. We wish to state that in our opinion the money devoted to it might be expended in a much more profitable direction. A reprint of Rafinesque's botanical and zoological papers, so that they can be made accessible to students, would be far more useful to science, and we are glad to notice that the same publishers (Jno. P. Morton & Co.) propose to issue a reprint of the Ichthyologia Ohiensis. We do not mean to intimate, in making this suggestion, that the works of Rafinesque ever had more than a very moderate scientific value, but he has added so much to the nomenclature that it ought to be possible to refer easily to them, whereas now many of them are inaccessible to most naturalists.

Rafinesque is well known as a most careless writer who inflicted endless difficulties on his successors. Some of the matter of his papers is fictitious, and much of it of such an indefinite character that it should not be admitted into scientific literature. Some naturalists have been at great pains to identify his species, but such identifications will be ultimately set aside, when a more critical spirit prevails among species zoologists. Money is so badly needed for scientific research and its publication, that it is melancholy to notice its perversion to such an object. It is also difficult to understand how any one who understands the true needs of science can devote his time to writing such a book. In concluding these remarks, we wish to emphasize the fact that Mr. Rafinesque was not a Kentuckian, nor an American, so that patriotic (!) motives can scarcely enter into the proposition.

—It is greatly to be hoped that the newly established Botanical Society of America can be induced to hold at least some of its meetings at the same times and places as the societies of Naturalists, Morphologists and Physiologists, for not a few will be members of more than one of these organizations, while there are many questions like those of evolution, heredity, geographical distribution, studies of the cell and of protoplasm, which, whether presented from the zoological or the botanical side are of equal interest to all. We notice that the provisions of the constitution of the new society are in effect that annual and special meetings are to be held at times and places appointed by the council, so that there is, in this respect, no trouble in affiliation with the older organizations.

—Professor W. W. Norman of De Pauw University goes to the place in the University of Texas recently vacated by C. L. R. Edwards, now of Cincinnati. In view of the treatment experienced by Dr. Edwards, the position can hardly be said to be a desirable one, and we withhold our congratulations until we see whether the university authorities know more or are more sensible of the advances of science than they were a few months ago. The best we can do is to extend our sympathies.

The numbers of the American Naturalist for 1894 were issued at the following dates: January, Jan. 25; February, Feb. 17; March, Mch. 8; April, Apl. 2; May, May 4; June, June 1; July, July 13; August, Aug. 14; September, Sept. 15; October, Oct. 10; November, Nov. 8; December, Dec. 5.

RECENT BOOKS AND PAMPHLETS.

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RECENT LITERATURE.

Seitaro Goto.—Studies on the Ectoparasitic Trematodes of Japan.[1]—This volume forms one of the most important pieces of work which has ever been written on the ectoparasitic trematodes, and is the result of about four years of careful and exact study. In the first part (176 pgs.) of the work, the author treats the anatomy in detail; then follow several pages of biological notes, a detailed account (pp. 182–253) of the classification, analytical key (pp. 254–261) to genera and species described, bibliography (pp. 262–267), and 27 finely drawn and well executed plates. Revised generic and specific diagnoses are given, together with a historical review of the different genera.

The following genera and species are described:—

I. MICROCOTYLE B. & H., 1863:—
 1. *M. caudata* n. sp., gills of *Sebastes* sp. sp.;
 2. *M. sebastis* n. sp., gills of *Sebastes* sp. sp.;
 3. *M. elegans* n. sp., gills of *Scombrops chilodipteroides*:
 4. *M. reticulata* n. sp., gills of *Stromateus argenteus*;
 5. *M. truncata* n. sp., gills of *Pristipoma Japonicum*;
 6. *M. fusiformis* n. sp., gills of *Centronotus nebulosus*;
 7. *M. chiri* n. sp., gills of *Chirus hexagrammus*;
 8. *M. sciænæ* n. sp., gills of *Sciæna sina*;

II. AXINE Abildg., 1794:—
 9. *A. heterocerca* n. sp., gills of *Seriola quinqueradiata*;
 10. *A. aberrans* n. sp., gills of *Belone schismatorhynchus*;
 11. *A. triangularis* n. sp., gills of *Anthias Schlegelii*;

III. OCTOCOTYLE Dies., 1850:—
 12. *O. major* n. sp., gills of *Scomber colias*;
 13. *O. minor* n. sp., gills of *Scomber colias*;

IV. DICLIDOPHORA Dies., 1850:—
 14. *D. smaris* Ijima MS., mouth-cavity of *Smaris vulgaris*, on caudal segment of a Cymothoa;
 15. *D. elongata* n. sp., mouth-cavity of *Pagrus tumifrons*, occasionally on the Cymothoa in the oral cavity;
 16. *D. sessilis* n. sp., oral cavity of *Choerops Japonicus*;
 17. *D. tetrodonis* n. sp., gills of *Tetrodon* sp., sp.;

V. HEXACOTYLE Blainv., 1828:—
 18. *H. acuta* n. sp., gills of *Thynnus sibi*;
 19. *H. grossa* n. sp., gills of *Th.* sp.;

VI. ONCHOCOTYLE Dies., 1850:—
 20. *O. spinacis* n. sp., gills of *Spinax* sp.;

VII. CALICOTYLE Dies., 1850:—
 21. *C. Mitsukurii* n. sp., cloaca of *Rhina* sp.?;

VIII. MONOCOTYLE Tschbrg., 1878:—
 22. *M. Ijimae* n. sp., oral cavity of *Trygon pastinaca*;

[1] Journ. College of Science, Imp. Univ., Tokyo. Vol. VIII, Part I, 1894, 273 pgs., 27 plates.

IX. EPIBDELLA Blainv., 1828: —

23. *E. Ishikawae* n. sp., gills of *Lethrinus* sp.?;

24. *E. ovata* n. sp., gills of *Anthias Schlegelii;*

X. TRISTOMUM Cuv., 1817: —

25. *T. sinuatum* n. sp., gill-plates of *Histiophorus* sp.;

26. *T. ovale* n. sp., oral cavity of *H. orientalis*, H. sp., and? *Cybium*;

27. *T. rotundum* n. sp., gills of *Xiphias gladius;*

28. *T. foliaceum* n. sp., gills of gen. sp. (Japanese Hazara);

29. *T. Nozawae* n. sp., fins of *Thynnus sibi;*

30. *T. biparasiticum* n. sp., carapace of a copepod (*Parapetalus*) and gills of *Thynnus albacora*.

It is somewhat striking that of all the thirty Japanese species described, the author does not consider a single one identical with any forms heretofore mentioned, but when one looks at the magnificent anatomical work contained in this volume he certainly feels very far from calling specific determinations into question.

Several points in Goto's interpretation of anatomical and histological structures are worthy of special notice: —

1. The prismatic, refractive fibres, which constitute the wall of the suckers in the genera *Axine, Microcotyle, Octocotyle, Diclidophora, Hexacotyle* and *Onchocotyle,* are usually looked upon as muscular fibres, but Goto agrees with Wright and Macallum (in *Spyranura*) in considering these fibres more of a non-contractile supportive, connective tissue nature.

2. The penis "is to be regarded as formed by an elevation of the wall of the genital atrium around the opening of the vas deferens and a simultaneous displacement of the latter from the base of the penis towards its top; so that the cavity of the penis is morphologically speaking as much the external surface of the body as the genital atrium, and the prostate glands are therefore to be regarded as a special modification of the dermal glands,—a view clearly in accordance with some facts observed [by Haswell] in Temnocephala."

3. Agreeing with Looss, Goto considers the vagina of the Cestoda homologous with the uterus of the Trematoda. Laurer's canal of the Digenea is homologized with the genito-intestinal canal of the ectoparasitic Trematoda, the receptaculum vitelli of *Aspidogaster* and the "anterior blind vagina" of *Amphilina.* While Looss looks upon the uterus of the Cestoda as homologous with the Laurer's canal of distomes, Goto homologizes the uterus of the Cestoda with the vagina of the monogenetic Trematoda. These homologies are discussed at length and are diagrammatically figured on Pl. XXVII.

For important and interesting discussions of other histological and anatomical structures we must refer to the original work.

C. W. STILES.

General Notes.

PETROGRAPHY.[1]

Composite Dykes on Arran.—Professor Judd[2] describes a number of "composite" dykes on the Island of Arran, in which the well-known "Arran pitchstone" and a glossy augite-andesite occupy different portions of the same fissure, either rock appearing in the center of the dyke, with the other on one or both of its peripheries, or the one rock cutting irregularly through the other. The relations of the rocks indicate that there was no regular sequence in the intrusion, the pitchstone having been intruded sometimes before, sometimes after the andesite. Each rock contains fragments of the other (in different dykes), and the two rocks are always separated by a sharp line of demarkation. The andesite is a basic rock containing about 56 per cent of silica, while the pitchstone is a pantellerite with 75 per cent of SiO_2 or an augite-enstatite-andesite with 66 per cent of SiO_2 and 4.13 per cent K_2O. The andesite is well characterised. It passes into a tholeite with intersertal structure, by a decrease in the glassy component, and upon further loss of glass it passes into diabase. The pitchstone is largely an acid glass, surrounding crystals of quartz, and microlites of augite, feldspar, magnetite, etc. The author adds to the list of individualized components already known to exist in the rock hyalite and tridymite. The latter mineral occurs in plates aggregated into spherules and globules that surround quartz crystals, and the hyalite forms globules scattered here and there through the glass. The author thinks that materials of such widely different nature as that existing in these dykes could not have been formed by the differentiation of a magma after its intrusion into the dyke fissures, but that the differentiation must have taken place while the magma was still in its subterranean reservoir.

Analyses of Clays.—Hutchings[3] quotes a series of analyses of carboniferous clays to show that these substances possess the requisite composition to become clay slates upon compression. He ascribes the small percentages of alkalies shown in most clay analyses to the fact

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Quart. Jour. Geol. Soc., xlix, 1893, p. 536.

[3] Geol. Magazine, Jan. and Feb., 1894.

that these analyses are of commercially valuable clays, selected for their small alkali contents. In the course of his article the author corrects some of the statements made in earlier papers and amplifies others. He declares that newly formed feldspar is present in the slates metamorphosed[4] by the shap granite and in other contact slates. In the spots of the shap rocks, and in those of other contact slates, there is always present, in addition to its individual components, more or less of a yellowish-green very weakly polarizing substance in which the other components of the spot are imbedded. This is believed to possess an indefinite composition, and to be the result of aqueo-fusion of some of the constituents of the original rock and the solidification of the product in an amorphous condition. The paper concludes with a statement of the author's views concerning the transformations that rutile, biotite, quartz, feldspar, cordierite and other contact minerals undergo in cases of contact metamorphism.

The Phonolites of Northern Bohemia.—The phonolites of the Friedländer district of North Bohemia are nosean bearing trachytic phonolites and nepheline-phonolites, according to Blumrich.[5] The latter contain phenocrysts of anorthoclase in a groundmass of sanidine, nepheline and aegerine crystals and groups of a new mineral which the author calls hainite. This hainite is a strongly refracting but a weakly doubly refracting colorless substance. It occurs in tiny triclinic needles with a density of 3.184. These unite into groups. It is found also as well-developed wine-yellow crystals forming druses in cavities in the rock. The mineral has a hardness of 5, and it is optically positive. It is supposed to be closely related to rinkite, hjortdahlite and the other fluorine bearing silicates common to the eleolite-syenites. In addition to hainite the druse cavities contain albite, chabazite and nosean. In the trachytic phonolites a glassy base was detected.

Spherulitic Granite in Sweden.—Loose blocks of spherical granite are reported by Backström[6] from Kortfors, in Orebro, and Balungstrand in Dalekarlien, Sweden. The rock from Kortfors is a hornblende granitite containing concentric nodules composed of four zones. The inner one consists of oligoclase, microcline and quartz; the second of oligoclase in radial masses and small quantities of hornblende, biotite, magnetite, orthoclase and quartz; the third of hornblende, biotite, oligoclase and a little biotite, and the peripheral zone

[4] Cf. American Naturalist, 1892, p. 245.

[5] Min. u. Petrog. Mitth., xiii, p. 465.

[6] Geol. Foren. i. Stockh. Förh. 16, p. 107.

of magnetite in a matrix of oligoclase. The structure of the spheroids, with the younger minerals nucleally and the older ones peripherally distributed, indicates to the author that they were produced by liquation processes. The rock from Balungstrand possesses a coarse groundmass consisting almost exclusively of microcline and quartz. The spheroids are essentially oligoclase spherulites peripherally enriched by biotite. They are clearly older than the groundmass.

Diabase and Bostonite from New York.—A few dyke rocks cutting the gneisses of Lynn Mountain, near Chateaugay Lake, Clinton Co., N. Y., are described by Eakle[7] as consisting of olivine diabase and of bostonite. The latter rock is porphyritic with phenocrysts of red orthoclase in a fine-grained groundmass with the trachytic structure. It differs from the other bostonites of the region in the presence of much chloritized augite in its groundmass. It is also more acid than these. Its analysis gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss	Total
67.16	14.53	4.17	1.26	.41	6.10	5.55	1.10 =	100.28

The olivine diabase differs from the ordinary ophitic diabases in that much of its augite is in idiomorphic forms. They thus resemble Kemp's augite camptonites.

Petrographical News.—A very interesting series of analyses of rocks from the central and northeastern portions of the Mittelgebirge is given by Hibsch.[8] The series includes analyses of phonolites, dolerites, camptonites, nepheline and leucite tephrites, augitites and basanites. Many of the rocks have been described in the literature.

Cohen[9] has obtained from the Transvaal, Africa, specimens of a calcite bearing aplite and of a melilite augite rock of a somewhat abnormal character. The aplite is from the mine of the Iron Crown Gold Mining Co., near Hamertsburg, and the melilite rock from near Palabora. The melilite rock is a fine-grained aggregate composed largely of honey-yellow melilites and black augites. On its druse walls are little crystals of the first-named mineral, and through the druse cavities extend thin plates of copper. In the thin section, clear, colorless melilites, with rounded outlines and olive-green grains of augite are seen to lie in an opaque granular groundmass in which are dots and flakes of copper.

[7] Amer. Geologist, xii, p. 31.

[8] Min. u. Petrog. Mitth., xiv, p. 95.

[9] Minn. u. Petrog. Mitth., xiv, p. 188.

Backström[10] fused feldspathic phonolite and obtained as the product upon cooling a colorless glass filled with microlites of oligioclase, nepheline, small microlites of colorless pyroxene and tiny grains of picotite and olivine (?). Upon fusing a leucite phonolite, containing nosean, SO_3 is driven off and the resulting product is a glass enclosing microlites of oligoclase, a few prisms of nepheline and abundant crystals of a yellow pyroxene with the properties of aegerine.

[10] Bull. d. l. Soc. Franc. d. Min., 1893, xvi, p. 130.

GEOLOGY AND PALEONTOLOGY.

Ancient Conglomerates.—The presence of intra-formational conglomerates is a not uncommon phenomenon. Dr. Walcott notes several localities where this form of conglomerate occurs in Paleozoic limestone formations, and describes typical ones found in Vermont and New York, Pennsylvania, Virginia and Tennessee. The author defines this species of conglomerate as one formed within a geological formation of material derived from and deposited within that formation. As to their origin, he offers the following theory. Low ridges or domes of limestone were raised above the sea level and were subjected to the action of sea shore ice and the aerial agents of erosion. In the intervening depressions of these ridges calcareous mud was being deposited which was solidified soon after deposition. The material forming the conglomerate was transported from the shore line and dropped upon the sea bed by floating ice. The facts from which these inferences are drawn are given in detail. (Bull. Geol. Soc. Am., Vol. 5, 1894).

Subterranean Waters on the Coastal Plain.—N. H. Darton has published a brief review of the geological conditions under which subterranean waters occur in the Coastal Plain region of the middle Atlantic slope, together with an account of wells bored. He shows that the geological relations are favorable to the wide circulation of waters at several horizons, and gives the approximate vertical positions and general areal distributions of these horizons. In southern New Jersey, Delaware and a portion of Maryland, the sand series of the Chesapeake formation are the principal water producers. Along the western edge of the Coastal Plain from Petersburg to Staten Island, the basal members of the Potomac formation yield water at moderate depths. The author gives also the "prospects" in several districts. About Norfolk, water will probably be found on the crystalline floor, 1,500 feet below the surface; in the peninsula region of eastern Virginia and Maryland, at the base of the Chesapeake beds at depths varying from 100 to 400 feet; on the "eastern shore" of Maryland there are many favorable prospects, successful wells being in operation, drawing their supplies from the Chesapeake, 200 to 300 feet below the surface, and from the Pamunkey sands, reached by 350, 440 and 910 feet boring. (Trans. Am. Inst. Mining Eng., 1894).

The Shasta-Chico Series.—The protracted investigations of Messrs. Diller and Stanton concerning the Cretaceous formations of western United States result in an accumulation of data on which are based a number of interesting conclusions. The Knoxville, Horsetown and Chico beds of northern California and Oregon are found to be continuous series of deposits and the authors accordingly propose for them the name Shasta-Chico series. The Wallala beds represent a phase of the Chico. The Mariposa and Knoxville beds are distinct faunally and are unconformable. Ther former is Jurassic, the latter Cretaceous. The attentuation of the Shasta-Chico series westward from the Sacramento Valley and the overlapping of the newer beds upon the older crystalline rocks of the coast range shows that the coast range was formed before the deposition of the Shasta-Chico series, and probably at the close of the Jurassic when the Mariposa beds were upturned.

The subsidence of the whole Pacific coast from Alaska to Mexico is shown by the successive peripheral attenuation of the lower beds and the landmark overlapping of the upper ones. The subsidence was probably not uniform throughout the whole region.

The final folding of the Sierra Nevada rocks and an uplifting of the range occurred at the close of the Jurassic.

The Shasta-Chico series represents the Cretaceous time from the beginning of the Lower Cretaceous to the Middle of the Upper Cretaceous, and it may be closely correlated with the Queen Charlotte Island and Nanaimo groups.

The evidence from fossil plants indicates that the Potomac epoch is included in that represented by the lower part of the Shasta-Chico series. It is also highly probable that the Comanche series of Texas and Mexico is contemporaneous with a large part of the Shasta-Chico series. (Bull. Geol. Soc. Am., Vol. 5, 1894).

A Gypsum " Cloche."—While excavating stone for plaster in the southern borders of the forest of the Montmorency à Taverny (Seine-et-Oise) a *cloche*, or natural cavity, was found in a mass of gypsum. This *cloche* is ellipsoidal in form, about 10 metres in length, and 5 to 6 metres high. The top of the cavity presents the peculiar appearance resulting from the slow dessication of the homogeneous rock. The sides are polished, with the edges of all the angles rounded off. The floor is an irregular heap of gypsum blocks of various sizes. Certain parts of this cavity are lined with small gypsum crystals.

That the cavity is the result of the action of water is undoubted, and three hypotheses are given as to the manner of erosion. (1) The water may have entered from above or laterally and slowly dissolved the gypsum. (2) The water may have entered from below through a fissure acting as a natural siphon. (3) There may exist, beneath the mass exploited, a subterranean stream flowing over a second deposit of gypsum. The second mass having been dissolved and carried away by the water would leave a cavity into which the first mass would fall. The cavern thus formed would fill with water percolating through the fissures, from which would result the phenomena of solution and curious recrystallization of gypsum observed on the roof and sides of the *cloche*. (Feuille des Jeunes Naturalitses, no date).

The Malaspina Glacier.—The term Piedmont has been applied to glaciers formed on comparatively level ground at the bases of mountains where the ice is not confined by highlands. They are fed by Alpine glaciers which spread out and unite with each other on leaving the valleys through which they descend from snow fields at higher elevations. The only known example of this class is the Malaspina glacier which occurs in Alaska, on the plain intervening between the Mt. St. Elias range and the ocean. A detailed description of this phenomenon by I. C. Russell was recently published, of which the following is an abstract.

The Malaspina glacier extends westward from Yakutat Bay for 70 miles, with an average breadth of 20 to 25 miles. It is a nearly horizontal plateau of ice. The general elevation 5 or 6 miles from its outer border is about 1,500 feet. It consists of three lobes, each of which is practically the expansion of a large tributary ice stream. The largest has an eastward flow toward Yakutat Bay, and is fed by the Seward glacier. It ends in a low frontal slope, while the southern border skirts the coast and forms the Sitkagi bluffs. The middle lobe is the expanded terminus of the Agassiz glacier flowing toward the southwest. This lobe is complete, and is fringed all about its outer border by broad moraines. The third lobe results from the union of the Tyndall and Guyot glaciers; it has a general southward flow and pushes out into the ocean, breaking off forms of magnificent ice cliffs.

On the north border of the glacier the surface-melting gives origin to hundreds of rills and rivulets of clear sparkling water which course along in channels of ice until they meet a crevasse or moulin and plunge down into the body of the glacier to join the drainage beneath. In the southern portion of the glacier abandoned tunnels 10 to 15 feet high made by englacial streams are sometimes revealed. The rapid melting of the surface ice produces curious phenomena. Where the ice is protected by belts of stone and dirt from the action of sun and air, the adjacent surface wasting away leaves ridges, while large isolated stones give rise to pinnacles and tables, but smaller ones, especially those of dark color, cause depressions.

The great central area of the glacier is composed of clear white ice which is bordered on the north by a broad, dark band of boulders and stones. Outside of this, forming a belt, concentric with it, is a forest covered area, in many places four or five miles wide. The forest grows on the moraine which rests upon the ice of the glacier.

The Malaspina glacier, in retreating, has left irregular hillocks of coarse débris which are now densely forest-covered. These deposits do not form a terminal moraine, but a series of irregular ridges and hills with a somewhat common trend. They indicate a slow general retreat without prolonged halts.

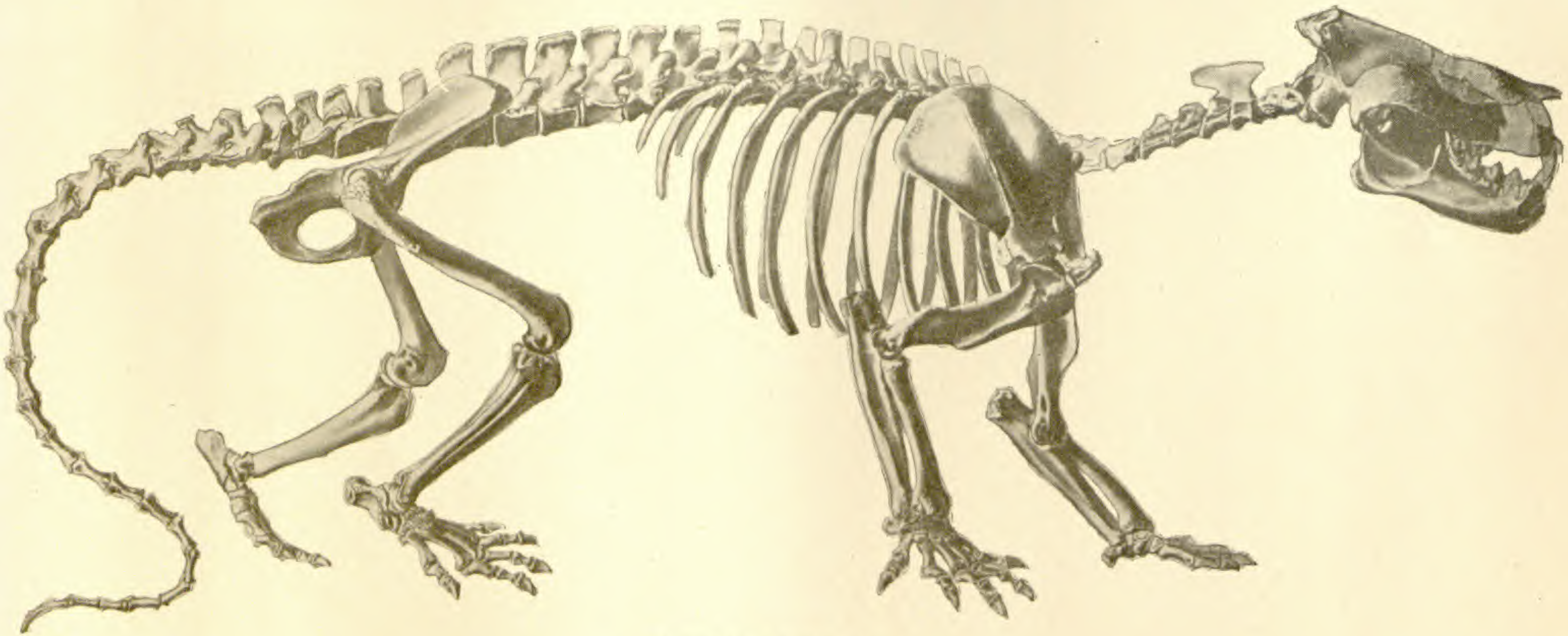
The outer portion of the barren moraine and the forest covered area characterized by innumerable lakelets from 100 feet to 200 yards across. They are generally circular and have steep walls of dirty ice which slope toward the water at high angles. Their presence in large numbers indicate that the ice must be nearly or quite stationary, otherwise the basins could not exist for a series of years.

On the west and north sides of the Chaix hills several typical "marginal lakes" occur similar to the well known Merjelen See of Switzerland.

The drainage of the Malaspina glacier is englacial or subglacial. Along the southern margin hundreds of streams pour out of the escarpment formed by the border of the glacier, or rise like fountains from the gravel accumulated at its base. All are brown and heavy with sediment. The most remarkable of these springs is Fountain Stream. It comes to the surface through a rudely circular opening, nearly 100 feet in diameter, surrounded in part by ice. Owing to the pressure to which the waters are subjected they boil up violently, and are thrown into the air to the height of 12 or 15 feet and sends jets of spray several feet higher. The waters rush seaward in a roaring stream 200 feet broad which soon divides into many branches, spreading a sheet of gravel and sand right and left into the adjacent forest.

About the southern and eastern borders of the glacier osars and alluvial cones abound. It is in this region that the ideal conditions for these formations exist. Here the ice sheet is stagnant on its border, and is retreating; it rests on a gently inclined surface, higher on

PLATE XXXIII.



Patriofelis ferox Marsh.

the southern margin than under its central portion, with high lands on the upper border from which abundant débris is derived.

There has been a recent advance and subsequent retreat of the glacier on its eastern margin. During its advance it probably extended to the ocean. There are several indications that the coast in the vicinity has been rising and that the process is still continuing.

Plistocene Problems in Missouri.—The three hypotheses as to the origin of the Boulder Drift and Loamy Clay in Missouri, north of the Missouri River, are briefly styled by J. E. Todd, the subglacial, the lacustrine and the fluviatile. The objection to the first is the great difference in altitude of the drift in Missouri and that in Illinois not fifty miles away, together with the absence of drift over Saint Louis County and down the valley of the Meramee, and also the apparent impossibility of the land ice reaching central Missouri without overflowing the Wisconsin driftless area. To the second and third hypotheses are opposed the nature of the deposits and the great width and depth of the troughs of the Missouri and the Mississippi Rivers. Todd confines himself to stating the problems without advancing any theory of explanation. Further research, he thinks, may remove the objections he finds in the last two and it is not improbable that the deposits may be accounted for by a combination of the lacustrine and fluviatile theories. (Bull. Geol. Soc. Am., Vol. 5, 1894).

Wortman on the Creodont Patriofelis.—Dr. J. L. Wortman has published, in the Bulletin of the Amer. Museum Nat. History of New York, a study of a remarkably perfect skeleton of the *Patriofelis ferox* Marsh, which he found in the Bridger beds of S. W. Wyoming. The species was described by Marsh under the name *Limnofelis ferox*. Limnofelis Marsh is shown, by the material described, to be synonymous with Patriofelis Leidy of earlier date, and Protopsalis Cope of later date turns out to have been founded on a species of the same genus. Wortman remarks of the genus: "The larger species, *P. ferox*, is one of the largest Credonts known, and equalled in size a full-grown black bear. The head was disproportionately large and massive, almost equalling in this respect an adult lion. The smaller species, *P. ulta* Leidy, was almost one-third smaller. In both there were a long and powerful tail, and broad plantigrade feet, which, together with other characters presently to be considered, lead to the conclusion that they were aquatic in habit."

As regards the systematic position of Patriofelis, Wortman says: "Its general skeletal structure is so much like Oxyæna, that notwithstanding the differences in the teeth they must be placed in the same family. Oxyæna is the older form and has the more primitive dentition but the differences are not greater than we would lead to anticipate in the ancestral genus. I think that it can be accepted as demonstrated that Patriofelis is the direct descendent of Oxyæna, which may likewise have given off a branch which terminated in the modern seals. It is somewhat doubtful whether this branch leads through Patriofelis." Concerning the habits of the Patriofelis, Wortman remarks: "From the structure of the limbs more than any other feature, I am led to conclude that it was aquatic or semiaquatic in its habits. The broad, flat plantigrade feet with their spreading toes suggest at the first glance their use for swimming. The eversion of the feet, together with the general clumsiness of the limbs, point, moreover, to the fact that the animal was not an active runner. Now, if the animal was aquatic, what was the nature of its food? It certainly could not have been fish, for the reason that the remains of fishes are very scarce in the Bridger sediments. If, however, we can form any judgment from their remains, the Bridger lake literally swarmed with turtles, and if Patriofelis frequented the water, it is highly probable that they formed a staple article of its diet."

Through the kindness of the American Museum authorities, we are able to give a figure of the restoration of the *P. ferox* (Plate XXXIII) which accompanies Dr. Wortman's article.

Geological News. CENOZOIC—The fossil flora collection from Herendeen Bay, Alaska, embraces 115 forms. These forms, according to Prof. Knowlton, are so closely related to those of Greenland, Spitzbergen and the Island of Sachalin that without doubt they grew under similar conditions and were synchronously deposited. The author agrees with Sir Wm. Dawson in regarding these floras of Eocene age rather that Miocene to which they have hitherto been referred. (Bull. Geol. Soc. Am., Vol. 5, 1893).

Prof. O. C. Marsh has recently given a brief description of a phalange of a large bird which was found in the Eocene of New Jersey. This is an interesting discovery. Unfortunately Prof. Marsh gives it a new specific and even a new generic name. As neither species nor genus can be recognized from a phalange, these names constitute an unnecessary addition to the waste basket of scientific literature.

Prof. Shaler offers additional evidence of orogenic action in producing the folds of the Cretaceous and early Cenozoic beds on the Island of Martha's Vineyard, Mass. As to the origin of those movements, the author inclines to the hypothesis that transfers of sediment tend to excite mountain building action. The exposures at Gay Head and elsewhere show that a great mass of sediment accumulated in that area in a brief period, and the orogenic movements of southeastern Massachusetts occurred shortly after this importation of detritus. (Bull. Geol. Soc. Amer., Vol. 5, 1894).

The record of striæ made by Mr. Tyrrell, during his exploration of N. W. Canada and Hudson Bay, shows that one of the great gathering grounds for the snow of the Glacial period in North America was a comparatively short distance west of the northern portion of Hudson Bay, and that from that centre the ice flowed not only towards the Arctic Ocean and Hudson Bay, but it extended a long distance westward towards the Mackenzie River, and southward towards the great plains, while Hudson Bay was probably open water. (Geol. Mag., Sept., 1894).

BOTANY.[1]

Dr. Kuntze's "Nomenclatur-Studien."[2]—Dr. Kuntze's latest contribution to the nomenclature problem is in the form of a reply to certain criticisms of Pfitzer upon his alterations of names in the *Orchidaceae*. Pfitzer's criticisms are to be found in Engler's *Jahrbuecher* XIX, 1–28. Kuntze answers him in the Bulletin of the Boissier Herbarium, II, No. 7, issued in July, 1894, in an article entitled *Nomenclatur-Studien*. While this article was provoked by the strictures of Pfitzer and deals principally with the nomenclature of the orchids, it is of especial interest to American botanists on account of some criticisms of two rules adopted in this country.

The first section of the article deals with names applied by Thouars to the orchids, which Pfitzer would reject. Dr. Kuntze discusses the matter thoroughly, although he had already gone over the ground in 1891 (Rev. Gen., II, 645–650), and certainly makes a convincing argument. In the course of his reply to Pfitzer on this point, he is led to restate his position on the question of "species-majority vs. place-priority," and to criticize the rule adopted by American botanists. This is done in the second section.

Section II, entitled "priority in place at all events and Article 55," is one of considerable importance. Dr. Kuntze in his *Codex Emendatus* (Rev. Gen., III, 1, CCCCV) proposes the following additions to article 55 of the Paris Code (I quote from his English text):

"A deviation from strict priority is necessary for genera published on the same day and united afterwards:

(1) "If they got no species at their first publication, the genus name to which in 1753 or afterwards was put the first specific name is legitimate.

(2) "If they got also their first species on the same day, the genus name having received most species on that day must be preferred". . . .

Instead of this criterion of "species-majority," American botanists have taken priority of place in the book in which both names were published. This criterion is undoubtedly simple, easy of application, and one obviating all discussions to which the application of the other might give rise. But Dr. Kuntze proceeds to make some applications

[1]Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

[2] Read before the Botanical Seminar of the University of Nebraska, Sept. 22, 1894.

of the rule which, as he says, operate as a *reductio ad absurdum.* He makes a list of genera subject to the operation of the rule, taken only from Linne's *Species* of 1753, and including good sized genera only. From this list it appears that the American rule will require the use of *Phaca* instead of *Astragalus*—involving the change of 1300 names—of *Sarothra* for *Hypericum,* and of *Amygdalus* for *Prunus.* In his list, taken only from the 1753 edition of the *Species plantarum,* and not an exhaustive one, the American rule will alter the names of 20 genera and 4600 species. None of these are affected by the species-majority rule; *Phaca,* which appears on page 755 of the *Species* above *Astragalus,* has there but 2 or 3 species, while *Astragalus* has 33. So *Pirus* on page 479 with 4 species, would have to yield to *Sorbus* on page 477 with 2—necessitating a change of 55 species at the present time. Are American botanists prepared to follow this rule consistently?

Section III is entitled "Compulsory Index for Plant-names." Dr. Kuntze points out that the enormous increase in botanical literature (there are 7000 titles a year at the present time), has made it impossible for any one to go over everything page by page as botanists could do formerly, and that what would have been gross carelessness at one time is almost a necessity now. He therefore proposes for discussion an article to the effect that articles, magazines and works, unless they have an index of names, including synonyms, to each volume, shall not be considered. It is certainly desirable that every work be well indexed. A book without an index, especially in these unsettled times when no one knows where anything will be placed to-morrow, is as good as sealed. But we may well doubt whether the corrective proposed is not too severe. Such penalties are not readily enforceable; and in the future, should a reaction set in against the rule, as usually happens with arbitrary rules of the sort, it would result in no little confusion by reason of the scope given for interference with established nomenclature.

The next two sections deal with some rejections of names made by Pfitzer. One point is of interest. Pfitzer in rejecting Kuntze's name *Sirhookera* takes occasion to make fun of it, a sort of objection to which, it must be confessed, too many of Dr. Kuntze's names are liable. Incidentally he compares it to "*Amtsgerichtsrathschultzia.*" Dr. Kuntze, as usual, comes back at him with a long list of such names coined by others, which must stand without doubt. And he points out in addition that Pfitzer retains a number of names with *du, de, O',* and *Van* prefixes, which are not dissimilar to *Sir* in *Sirhookera.* As far as the *validity* of such names goes, Dr. Kuntze is doubtless quite right. That they are not to be commended and that we have far too many already without any fresh creations of the same sort, is readily apparent from an inspection of the list which he cites in his justification.

Section VI is devoted to a discussion, apropos of certain changes made by Pfitzer, of the "once a synonym always a synonym" rule. This rule is one which commends itself to all who have had anything to do with nomenclature. In their determination to confer upon some one the honor of a genus dedicated to his memory—a doubtful honor since it has been so frightfully abused—botanists have multiplied homonyms in some cases to an incredible extent. The rule seems to have been "if at first you don't succeed," try again indefinitely till you succeed in making the name stick. In Section 9 of the introduction of his *Revisio Generum,* Dr. Kuntze referred to this practice as an "abiding source of danger to botanical nomenclature." And in the same place he gives a list of 150 personal genus names which have been repeated in this manner, two seven times, two six times, and fourteen five times. One of the most confusing results of this species of synonyms is the condition of oscillation in which it often places a name. A recent case may serve as an example. In his monograph of the *Onagrariae* in the *Pflanzenfamilien,* Dr. Raimann in subdividing the genus *Oenothera,* revived Spach's genus *Kneiffia.* This name is one year older than *Kneiffia* of Fries, so that *K. setigera* Fr. must have a new name. But supposing future monographers should differ with Raimann as to the limitation of *Oenothera* and *Kneiffia* Spach should become a synonym once more, then, according to the ordinary rule, we should have to restore *Kneiffia* Fr., and the new name would serve only to swell the crowded ranks of synonyms. In this way the name of a genus of fungi could be kept in a state of oscillation for an indefinite period, depending all the while on the views held by phanerogamists as to the limitations of a genus of flowering plants. This is a state of affairs which mycologists cannot be expected to tolerate, and can result only in disregard on the part of monographers of the rules which permit such things. Many similar cases might be cited. It is apparent, then, that some rule is necessary by which this difficulty of genus-names in a state of indefinite suspension can be obviated. The plan which at once suggests itself is to invalidate all subsequent homonyms, so that after a name has been once used it cannot be applied to another group. This is done by the "once a synonym, always a synonym" rule.

But Dr. Kuntze, while recognizing the necessity of some such rule, points out that if given retroactive force, the rule in question will involve us in no little difficulty. He gives a list of 200 generic names, all personal names, which must be rejected under the rule, and states that an exhaustive list would include from 500 to 600 generic names and involve about 7000 species. To this formidable number, should be added a large number of species which will be affected by the application of the rule to specific names. Not only is the rule open to this objection, but Dr. Kuntze makes the further point that, like all retrospective legislation, it does great injustice to past workers who knew no such rule. He, therefore, objects strenuously to any retroactive application of it. But, on the other hand, he recognizes the necessity of making provision for cases like the one detailed above, and he has a suggestion which is well worth considering. In his *Codex Emendatus* (Rev. Gen. III, 1, CCCXIII), he proposes the following addition to Article 60 (I quote from his English text): "Existing homonyms invalidate such homonyms as are in future competitory, or newly established, or renewed." That is, he proposes that the rule be applied to all future cases, and that a name valid now shall not in the future be superseded by any revived homonym. That would obviate the dif ficulty suggested in regard to *Kneiffia* above, and would certainly accomplish all of what is intended by the American rule, without necessitating so many alterations. Dr. Kuntze points out in the present article the impossibility of any permanent nomenclature in large genera without some rule against the revival of homonyms. As an instance he mentions the genus *Panicum*. He says that in working over the species of this genus in his collections "when I found an older name for a species, there were generally also homonyms of other species forthcoming; about which, however, one did not know whether they were valid or not." The only solution of this is a rule which makes a synonym once a synonym for all time. Whether this rule should be made retroactive, or should be applied only to future cases, i. e. to prevent the renewal of existing homonyms and the creation of new ones, is a question which must be decided by those who, from their investigation of the matter, are competent to pass upon it. Dr. Kuntze's suggestion seems to be a wise one and seems to cover all that is required.

The remainder of the article is taken up with the nomenclature of the orchids, and a concluding section relating to a future congress.

Dr. Kuntze has been subjected to a great deal of criticism, some of it unnecessarily severe, though his controversial methods are not always calculated to placate his opponents. But whatever may be thought of some of his suggestions, we can have little sympathy with those who, as Pfitzer seems inclined to do, charge him with wanton alterations or selfish motives. On the contrary, there is every reason to accept his statement that he was led into the work of reforming nomenclature in the course of the investigation of his collections, a natural thing when dealing with plants collected in every quarter of the globe, which would bring out the defects of our present nomenclature in a most striking manner. After all his work has but served to bring vividly before us what all were dimly conscious of before. Every man for himself was the principal rule of nomenclature in practice. We must at least admire Dr. Kuntze's persistence in endeavoring to bring about uniformity and a better state of things.

ROSCOE POUND.

Notes on the Trees of Northern Nebraska.—These notes apply to the region embraced in Antelope, Holt, Boyd, Rock, Brown, Keya Paha, Cherry, Sheridan, Dawes, and Sioux Counties. In the last three my observations have been much more limited, and, I doubt not, need extension and revision. They are simply good as far as they go.

The country is composed of sandhills interspersed with small lakes, ponds and streams, hay-flats in the moister valleys, and dry valleys between the rows of sandhills, with stretches of dry, firm table-lands, usually abruptly separated from the sandhill portions by a deep cañon stream. With few exceptions, the trees are confined to these cañons, which branch out into the hill-sides in long reaches, some dry, others worn by unfailing spring brooks or "creeks," as they are generally called.

There is good reason to believe that this treeless region was not always thus. On the tops of some of the sandhills have been found decaying trunks of Pine and Red Cedar buried deep in sand, bearing witness to a different condition of moisture in years gone by. In common with most observers, I think, I attribute the change to the destructive prairie fires that have swept over this region from time immemorial. They form one of the chief obstacles, to-day, to the regeneration of the land. The deep cañons are lined, when dry, from summit to base, with *Pinus ponderosa scopulorum* Engelm. A few scattering specimens are found extending several hundred feet upon the neighboring table. When the base of the cañon is wet, the Pine is found only above the line of moisture. It plants its feet in the gray magnesian, and soft limestone and sandstone rocks, and in the driest season never seems to lack moisture. It belongs to the foothills of the Rocky Mountains, but extends eastward as far as the west line of Holt County in the Niobrara Cañon. The coincidence, at this point, of the Black Walnut (*Juglans nigra* L.) with the Bull Pine is remarkable. In the cañon at Long Pine are many flourishing specimens, young and old, one with the diameter of three feet. The young ones prove that it sometimes fruits, in spite of the late spring frosts. Its western limit is nearly coincident with Brown County and the 100th meridian.

A large block of Black Walnut was found in Cherry County five years ago, not far from Fort Niobrara, and was preserved by Surgeon Wilcox, showing that it once extended further west. This region furnishes but one oak (*Quercus macrocarpa* Michx.), which grows to a large size. It takes the moist and the dry portions of the cañons about equally, where the soil is at all loamy, leaving the most barren parts to the Pine. Its western limit is about the mouth of Snake Creek, Cherry County, about ten miles west of Valentine.

A rare and notable tree is the Canoe Birch (*Betula papyrifera* Marsh), which flourishes only where a dark and sheltered spot is furnished by a steep declivity with a northern exposure. At Fort Niobrara, where these conditions occur in their perfection, surrounded by rare plants such as *Lonicera hirsuta, Circaea lutetiana, Osmorrhiza claytoni, Carex eburnea,* the two latter not having been found elsewhere in Nebraska. You may see noble specimens of this Birch thirty inches in diameter. It is reported sixty miles west and further east on the Niobrara.

The region affords no more useful and hardy tree than the Ash, of which we have two species:—the common species from Antelope County west to Brown is *Fraxinus lanceolata* Borck., from Brown Co. west to the Hills, *Fraxinus pennsylvanica* Marsh. It is not always easy to distinguish them, as Gray gives a pubescent form of the Green Ash. It occupies the same soil as the Oak, running from the water's edge over the cañon line upon the prairie, where it has been fortunate enough to escape destruction from fire. We have no tree more capable of enduring the rigors of drouth, heat and cold. It seldom attains a size of over thirty inches in diameter.

The Basswood (*Tilia americana* L.) is found along the Niobrara in Brown County, and probably further east; apparently reaching its western limit in Cherry County, about four miles west of Valentine. It affects the borders of streams.

I can find but one elm (*Ulmus americana* L.), though *Ulmus fulva* Michx. has been reported from Long Pine Cañon. This elm is one of the best trees for the region, not only flourishing on the water line, but capable of growing on the uplands almost as well, if protected from fire. It attains a diameter of about four feet, and is universal. The Hackberry is found with it (*Celtis occidentalis* L.), but is much less common and only half the size.

The largest tree of the region is the Cottonwood (*Populus monilifera* Ait.), one specimen in Hat Creek Basin, Sioux County, having a diameter of over five feet. This species is common everywhere along streams, and quickly establishes itself in low meadows by means of its tufted seeds, if not destroyed by fire or mowing-machine. In Dawes and Sioux Counties, *Populus angustifolia* James is found in similar situations. One or two others have been reported.

The only tree willow of the region is *Salix amygdaloides* Anders. I long supposed that *Salix nigra* was common throughout the State, but can find no trace of it here. This tree hangs over the streams, reaching a foot or more in diameter. In this connection it is desirable for me to state that since writing on the shrubs of this region (September NATURALIST, p. 803), in which I mentioned a large willow of the *Cordata angustata* variety, at Ewing, Holt County, I measured the "shrub" in question, and found it twenty-eight inches in circumference, and eighteen feet high, several similar trees growing in the one clump from one root. I think we may say that it has reached "tree-like proportions," though retaining the habit of the shrub.

—J. M. BATES.

Valentine, Nebraska.

Messrs. Rand and Redfield on Nomenclature.[3]—A new contribution to the nomenclature problem has recently appeared in the form of a protest against the Rochester Rules in the Introduction to Rand & Redfield's "Flora of Mount Desert." Although the phases of the question there discussed are by this time rather hackneyed, the tone of the article is so confident, and some of its positions are so amazing, that a few remarks thereon may not be amiss.

Had the authors contented themselves with stating that they adopted the nomenclature of Gray's Manual because most of those who would have occasion to use their book would be likely to use it in connection with the Manual, nothing could be said. Such a course has much to be said in its favor. But they have thought best to strengthen their con-

[3]Read before the Botanical Seminar of the University of Nebraska, Nov. 3, 1894.

clusion by an attack upon the Rochester Rules, upon the principles upon which they suppose them to be based, and upon their framers. In the course of this they display a most wonderful ignorance of the whole subject.

In the first place they assume that there was, up to the time the Rochester Rules were framed, a generally received nomenclature, and that the rules in question have overturned it—or have attempted to overturn it. To use their own language, they state that the Rochester Rules are intended to " upset important results of nomenclature evolution for a century and a half." The notion that there has been any fixed or well-defined set of rules "generally followed," or any "generally received" nomenclature, is mostly confined to those whose acqaintance with botanical literature begins and ends with Gray's Manual. To others it has long been apparent that the only generally received. principle was, for the monographers, everyone for himself, and, for the rest of the world, follow the latest monographer. It was to put an end to this, for America at least, and to establish a nomenclature which might have some chance of becoming generally received, and which the next editions of our manuals could not overthrow at the caprice of their authors or editors, that the Rochester Rules were framed.

I have said that the notion that there was a "generally received" nomenclature, was confined mostly to the readers of Gray's Manual. But an examination of that work will speedily show that even the illustrious author of the Manual was far from being sure of " where he was at " in nomenclature.

In the preface to the last edition of the Manual, the editor states that the nomenclature there used conforms to the latest views of Dr. Gray. A comparison with the nomenclature of the preceding editions is, therefore, interesting. One of the first things that one notices is that many changes in the nomenclature of the fifth edition have been made to conform to the " Kew Rule." For instance:

In the fifth edition we find: *Chiogenes hispidula* Torr., *Ilysanthes gratioloides* Benth., *Xerophyllum asphodeloides* Nutt., *Bouteloua curtipendula* Gray. These specific names represent in each case the oldest name: *Vaccinium hispidulum* L., *Capraria gratioloides* L., *Helonias asphodeloides* L., *Chloris curtipendula* Michx. In the sixth edition these appear as *Chiogenes serpyllifolia* Salisb., *Ilysanthes riparia* Raf., *Xerophyllum setifolium* Michx., *Bouteloua racemosa* Lag., the names allowable under the Kew Rule. In the 1848 edition also, we find *Bouteloua racemosa*. That is, in 1848, Dr. Gray followed the Kew Rule in this particular instance, while disregarding it in the other cases mentioned.

In 1868, he thought otherwise as to this one name and used the oldest specific name, while adhering to the Kew Rule in many cases (e. g., *Lophantus anisatus* Benth. = *Hyssopus anisatus* Nutt., 1818, = *Stachys foenicula* Pursh, 1814). In 1889, his editor, representing "his known and expressed views," changed about as to all of the names in the list just given, and altered a large number of names to conform to the Kew Rule, still, however, disregarding it in some cases. At the same time the editor stated that "reasonable regard" had been had to the claims of priority! This last promise was fulfilled by changing about a dozen specific names and two or three generic names so as to use prior names. For instance, in the fifth edition we find *Nelumbium* Juss. In the last edition, *Nelumbo* Tourn. The name which the Rochester Rules would require is *Nelumbo* Adans. If the editor was willing to alter the name to which Dr. Gray had given currency for thirty years, and to go back to Tournefort for a name, others can scarcely be blamed for following his example in similar cases, and going back at least to the time of Linné. A long list might be made showing the wholly arbitrary and personal character of the alterations made in the nomenclature of the successive editions of the Manual. It is needless, however, since the facts are generally known. No reproach is implied in this so far as the illustrious author of the Manual is concerned, for he only did as all others were doing—namely, followed his personal inclination at the moment in each specific case. But such a condition was a reproach to botanical nomenclature, and could only result in a revolution.

While American botany was in its infancy, it was natural that all should follow blindly in the wake of one great man. It is no less natural that the botanists of to-day should demand something more than a great name to justify uncertainty and vacillation in nomenclature. It is, in reality, the so-called conservatives who stand for disorder and confusion in nomenclature. *They* are the "Rip Van Winkles just awakened from a comfortable nap of years," and somewhat rudely awakened, too, thanks to Dr. Kuntze, and not over-clear in consequence as to who or where they are.

It takes but a moment's glance at the successive editions of the Manual to show how utterly baseless is the notion that the framers of the Rochester Rules are seeking to overthrow "well-established principles of property rights, custom, usage, and the well-established maxim, *quieta non movere*." The greater part of the rules adopted at Rochester were rules which botanists had, for many years, at least professed to recognize. The fact that the only representative body of American botanists was compelled to legislate on the subject shows of itself that the state of nomenclature was far from quiet. Anyone who thinks that all was peaceable and serene till Dr. Kuntze and the Rochester Rules came down upon the fold, should be somewhat cautious in his references to Rip Van Winkle. When the most conservative of authors fails to reveal any system or principle consistently followed out in the several editions of his widest known work, and when contemporary works are in hopeless disagreement with themselves and with the Manual, it sounds somewhat strangely to be told that we are cutting "the solid ground from beneath our feet" in laying down a set of rules and principles and agreeing to abide by them. When everybody made changes in nomenclature to suit his personal fancy, no one made any remonstrance, and we all followed the changes of the latest monographer without hesitation. It is only since this state of affairs has become intolerable to the majority of American botanists, and they have resolved to make changes in nomenclature according to rule and principle, and not according to personal taste and caprice, that any complaint has been heard.

The authors also protest against the representative character of the members of the Rochester and Madison meetings, and refer to them as "comparatively few botanists of various degrees of repute." Whether this means that Boston still thinks herself the centre and focus of American learning in all branches, and that the authors regard all of those poor mortals who do not live in the shadow of Cambridge as intruders, or whether it is only another instance of Rip Van Winkle, one need not enquire. The remarks of the authors remind one of some editorial sayings in Zoe *apropos* of the Madison Congress and of the American Botanical Society. The botanists who dissent from the principles of the Rochester Rules certainly have not made much "noise," and the world at large is likely to be glad to know who they are. It will also be glad to know who those botanists are who possess "that added grasp of affairs" which, we are told, in addition to mere knowledge of herbaria and of the literature of the subject, is necessary to qualify a botanist and make him competent to pass on questions of nomenclature. The statements as to the *personnel* of the Rochester meeting fall little short of impertinence.—ROSCOE POUND.

Botanical News.—The University of Chicago announces botanical lectures and laboratory work by Dr. John M. Coulter, who is styled the Professorial Lecturer on Botany. This would seem to indicate that eventually this great University may call Dr. Coulter to build up a department of botany commensurate with its importance.

In September the National Herbarium in Washington was transferred from the Agricultural Building to fire-proof rooms in the eastern pavilion of the National Museum. It will still be under the control and care of Chief Botanist Coville and his corps of assistants.

Parts I and II of the "Flora of Nebraska" by the Botanical Seminae of the University of Nebraska have been published. They aggregate seventy-eight pages of descriptive text and thirty-six plates, and include the Schizophyceæ, Chlorophyceæ, Coleochætaceæ, Rhodophyceæ and Charophyceæ.

The Proceedings of the Madison Botanical Congress have been issued by the Secretary, Dr. J. C. Arthur, of Lafayette, Indiana, in a neatly printed pamphlet of sixty pages.

ZOOLOGY.

Terminology of the Nerve Cell.—Fish attempts[1] to avoid some of the confused terminology of Neurology by proposing a consistent nomenclature, adopting to some extent existing terms. Thus he would call the entire nerve cell, with its appendages, neurocyte; the axis cylinder prolongation; neurite; the other processes dendrites, and the neuroglia cell, spongiocyte. Nerve cells would then be dendritic or adendritic, mono-or dineuritic, etc., according to the number and character of the processes concerned.

Structure of Clepsine.—Oka has attempted[2] the solution of some of the problems of Hirudinean anatomy. After some remarks on external morphology, he takes up in succession the body cavity, blood vessels, nephridia and the systematic position of these animals. The text is rendered much more easy of comprehension from the reconstructions on the plates. Oka recognizes in the lacunæ of the body the true cœlom which is broken up into a large number of anastomosing cavities, in which may be recognized the following principal regions: in the middle of the body, a median dorsal and a median ventral lacuna, in each of which run blood vessels. In front and behind these fuse into a " median " lacuna. These lacunæ are connected by short canals with a complicated " zwischenlacuna," which runs the length of the body on either side, and this in turn by segmentally arranged tubes with a lateral lacuna on either side. These various spaces are also connected with a subepidermal system of lacunæ, the principal canals of which correspond to the annuli of the external surface. In the blood vascular system, which is cut off completely from the lacunar cavities, segmentation has largely disappeared. In but few regions can even the most remote resemblance to a segmental arrangement of vessels be traced, although the dorsal vessel shows segmental enlargements. The nephridia are described at length, the account confirming and supplementing the descriptions of Whitman, Bourne and others, and disagreeing *in toto* with those of Bolsius, except in that they confirm the latter in the description of an ectodermal terminal portion.

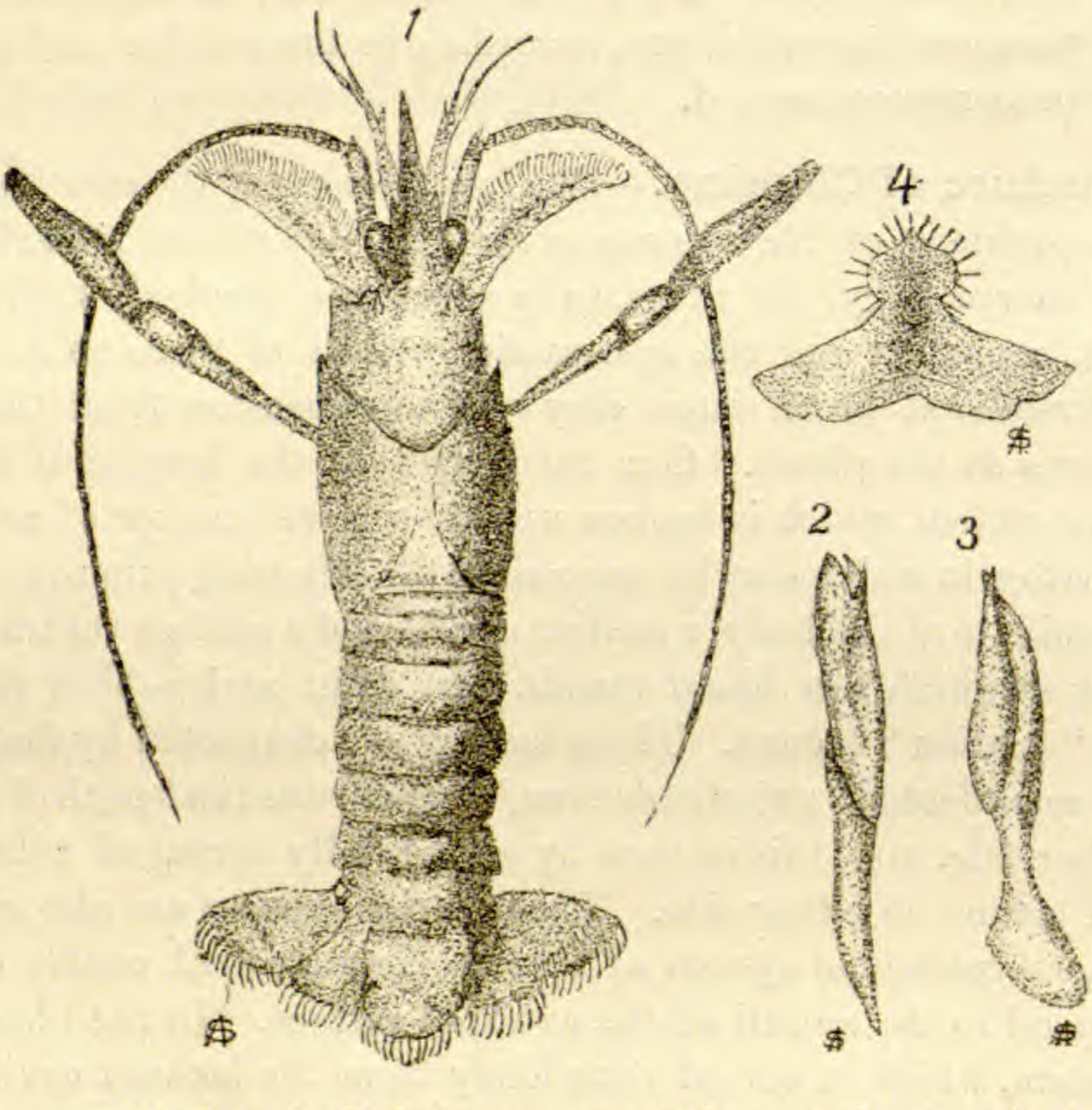
In conclusion, Oka thinks the Hirudinei nearest the Oligochætes, basing this view upon chiefly three factors: (1) the existence of a seg-

[1] Jour. Comp. Neurology, iv, 1894.

[2] Zeitschr. wiss. Zool., lviii, 1894.

mented cœlom; (2) a blood vascular system distinct from the cœlom and (3) a pair of nephridia in each somite; points which it seems to the present writer, imply only Annelid affinities since they fit Polychætes as well as Oligochætes.

A new Cambarus from Arkansas.—*Cambarus faxonii* sp. nov. Male, form 1, rostrum broad, elongate, deeply excavated above, margins raised into sharp parallel ridges, each ending in prominent spines Acumen very long and slender, curved upwards; post orbital ridges prominent, each ending in a prominent spine.



Carapax cylindrical, slightly compressed, smooth; cervical groove moderate, a prominent spine on each side. Distance from cervical groove to posterior margin of carapax $2\frac{1}{2}$ to 3 in distance from cervical group to tip of acumen, and equal to length of acumen. Anterior 1–2 of the areola narrow, its posterior portion triangular. Abdomen broad and slightly shorter than cephalothorax (including acumen). Outer posterior part of telson ending in a prominent spine inside of which is a much smaller spine, posterior margin of telson slightly emarginate. Anterior process of epistoma triangular. Basal segments of antennules with a spine on under inner border, about middle of segment. Antennæ shorter than the body, antennal scale long and narrow (i length almost three times its greatest width), slightly curved outward and ending in a sharp spine, equals the rostrum.

Basal segment of antennal scale with a prominent spines on anterior lateral borders. Chelipeds slender, not tuberculated, slightly hairy; fingers shorter than hand, opposed margins of the fingers straight, hand smooth; carpus smooth; a spine on inner and outer distal borders. Meros smooth with one spine on upper and one on outer side, and two below, all spines on distal 1–3. Third pair of legs hooked, fifth pair with a small roundish tubercle on basal joint.

Anterior abdominal appendages strong and of moderate length, tips reaching between third pairs of legs, bifid at apex, apex of inner part posterior and acute, its tip turned slightly outward, outer bluntish.

Color of this species somewhat mottled with bluish on antennal scale and rostrum, forming cross bars.

This is apparently a small species. The largest specimens taken were females, length (from tip of acumen to posterior margin of telson) of largest specimens, 2½ inches. The size of average males, 2¼ inches.

This species is easily recognized by its long, slender acumen, small hand, slender antennal scale and its small size. Found in St. Francis River at Greenway and Big Bay. It is by no means abundant. This and young of one other species, *C. palmeri*, are all I found in the St. Francis River.

Named in honor of Dr. Walter Facon, to whom we owe more than to anyone else our knowledge of North American crayfishes.

EXPLANATION OF FIGURES.

1. Dorsal view of specimen, x, 1.31.
2. Abdominal appendage, inner view, x, 4.35.
3. Abdominal appendage, posterior view, x, 4.35.
4. Epistoma, x, 4.

The drawings were made by Miss Allie Simonds, Arkansas University, Class 1895.

S. E. MEEK,
Arkansas University,
Oct. 22, 1894, Fayetteville, Ark.

A New Bassalian Type of Crabs.—In a recent number of the Journal of the Asiatic Society of Bengal (v. 63, part 2, No. 3), a most remarkable crab has been described and illustrated by Messrs. A. Alcock and A. R. Anderson. It has been designated (p. 141) as "*Archæ-*

oplax, a Gonoplacid (?) crab of a remarkably antique facies, which appears to be closely connected also with *Cymopolia*."[3]

The description and figures appear to me to indicate that the new crab has no close relationships with either the Gonoplacids or *Cymopolia.*

Through the kindness of Miss Rathbun, of the Invertebrate department of the U. S. National Museum, I have been able to study specimens of all types and compared them with the data respecting *Archæoplax*, and could find no special features of agreement. *Archæoplax*, it seems to me, must be considered entirely independently of the types with which it has been contrasted.

I may preface the further remarks I have to make with the statement that the crab so called by Messrs. Alcock and Anderson cannot retain the name given to it by them—*Archæoplax*—as precisely the same form had been bestowed more than 30 years ago on an extinct genus, also of the superfamily of Grapsoidea, represented by fossils from Gay Head, Mass. *Archæoplax signifera* was the name given by W. Stimpson to miocene tertiary remains found there, and described in the Boston Journal of Nat. Hist. (vol. 7, p. 584, 1863).

As a new name is therefore necessary, I would suggest as eminently appropriate for the crab made known by Messrs. Alcock and Anderson, the generic designation *Retropluma* (*retro*, back or backward, and *pluma*, a soft feather). The applicability will become evident in due course.

When I first saw the figure of the mouth parts I inferred that the external pair of maxillipeds had been lost, but Messrs. Alcock and Anderson expressly declare (p. 182) that "the external maxillipeds are so small and slender as to leave completely exposed the mandibles, the wide endostome, and a part of the wide and produced efferent branchial channels." They give the figures as those of a perfect animal, and apparently had a number of specimens.[4] We are, therefore, placed in the dilemma of assuming that the crab differs radically from all others, or that the learned authors may have been mistaken; I prefer, in this dilemma, to leave the question open for re-examination by the original describers.

The new type, however, differs in another character almost as remarkable as would be such an extreme and anomalous modification of the maxillipeds supposed by its describers.

[3] It is later (p. 180) suggested that "its nearer affinities are, perhaps, with the Macrophthalmines."

[4] "Bay of Bengal, at almost all stations off the Coromandel coast, from 140 southwards, between 100 and 250 fms." P. 183.

"The fifth pair of trunk legs is quite unique in form and disposition: they arise quite close to the middle line of the body and high up, almost on the back; they are short, being considerably less than the breadth of the carapace in length, and are very slender and flexible; and they are so thickly fringed with shaggy hairs as to appear like feathers."

This peculiar modification of the last pair of limbs is very unlike that of the corresponding legs in the notopodous or anomurous brachyurans, and indicates that some special function may be assumed. The loss of geniculation and the straightness, the slenderness and flexibility, and the dense hairylike covering must mean something. May it not be that the peculiarly modified limbs have been specialized for purposes of aërification of an increased vascular supply, and that they have become functionalized as branchiæ? Until some better hypothesis can be suggested or tested by histological examination, bold as it may seem, the explanation cannot be considered irrational.

As has been already remarked, *Retropluma* has no close relationship with the forms compared with it or with any other known types. It should, therefore, be regarded as the representative of an independent family—*Retroplumidæ*—especially characterized by the peculiarly modified fifth pair of feet, want of true orbits, and position of the antennæ. For the present it may be retained in the superfamily or tribe *Grapsoidea*, on account of the reduced number of branchiæ ("six on each side") and form of body. If, however, the illustrations and description of the mouth parts are correct, it must be widely removed. The only known species is *Retropluma notopus*.

I cannot appreciate any "remarkably antique facies in the new crab." On the contrary, it appears to be a form excessively modified for deep sea life.—THEO. GILL.

Note on the Occurrence of Hyla andersonii in New Jersey.—About the middle of June, 1889, Mr. Louis M. Glackens and the writer were engaged in general biological studies along the Atsion and Batsto Creeks, in Atlantic and Burlington Counties, New Jersey. On the night of June 17th we stopped at Pleasant Mills. Shortly before sundown a thunder storm arose, just previous to and during which the frogs became very noisy in a swampy thicket near by.

The note was an unfamiliar one and invited investigation, which resulted in the capture of two specimens of this handsome and rare species. The shrill quack-ack, which at the time was compared to the note of a frightened guinea fowl, and which is not unlike the call of a rail, was constant and seemed to come from every tree; but during our progress through the thicket the voices immediately around us, for a radius of about 25 feet, were silent. This circumstance and the oncoming darkness made it difficult to secure specimens, although the frogs were so abundant. The two secured were found perched on the lower sides of branches of the pines with dilated and vibrating throats, though at the moment they were silent; and it was noted that they emitted an odor which was likened to that of raw green peas. The color above in life was a bright pea green, quite unlike the dull olive green of spirit-preserved specimens. The lateral stripe was of a very rich velvety purple. The following morning we could find no trace of them, but later in the day heard another chorus in the middle of a dense swampy thicket. Since then Mr. H. F. Moore and myself have repeatedly visited the locality in quest of the Hyla and its eggs, but entirely without success. To the natives the frog is unknown.—J. Percy Moore.

Yolk Nucleus of Cymatagaster.—J. W. Hubbard, in a paper,[5] the proof-reading of which could be better, shows that the yolk nucleus in these fish eggs is produced from the true nucleus, soon after the cell becomes differentiated as an egg, that it migrates towards the vegetative pole, and after the closure of the blastopore, it breaks up and disappears in the yolk. He claims that the same structure occurs in many eggs and has been mistaken for the spermatozoon, and thinks it homologous with the meganucleus of the Protozoa, a conclusion which needs more support than is advanced in the paper. The review of the literature omits several important papers.

Zoological News. Protozoa.—Gruber, in his Amöben-Studien,[6] comments on the great rarity of observations on the division of the Amœba, and especially calls attention to the absence of any observations upon the mitotic division of the nucleus. He calls upon other observers to make observations on this point. He has had an opportunity of directly comparing Rhizopods from Massachusetts and from the Black Forest, and says that the forms from the two localities are identical. Some remarks are made upon specific characters in the Rhizopods.

Cœlenterata.—Grieg, in a paper but recently received,[7] catalogues 30 species of Pennatulida as belonging to the Norwegian fauna.

[5] Proc. Am. Philos. Soc., xxxiii, 1894.

[6] Bericht Naturf. Gesellsch., Freiburg, viii, 1894.

[7] Bergens Museums Aarsberetung for 1891, 1892.

Apellöf, in the same volume, describes several structures in the anatomy of Edwardsia. Among the points brought out are the presence of a nervous system in the capitulum, the absence of siphonoghyphes, of septal stomata, of acontia. Its nearest affinities appear to be with Protanthea of Carlgren (1891).

WORMS.—Stiles calls attention [8] to the discovery in a cat, by H. B. Ward, of *Distoma westermanni*, a fluke new to the U. S. The same species is a common parasite in man in Eastern Asia.

Ward describes [9] *Distoma opacum*, parasitic in *Amia calva*, *Ictalurus punctatus*, and *Perca flavescens*. In its structural characters the species is closest to *D. pygmæum* of the eider duck. The fish become infested by feeding upon crayfish (*Cambarus propinquus*), in which the parasite was found encysted.

CRUSTACEA.—Miss Mary J. Rathbun describes[10] four new species of crabs from the Antillean region and gives[11] a series of notes upon the species of Inachidæ in the National Museum. There seems to be a tendency in these and other papers to differentiate genera and species on too minute and too variable characters, which, we hope, will not be continued in the promised Synopsis of North American Crustacea.

ARACHINDA.—Purcell's complete paper on the eyes of harvestmen has appeared,[12] and the illustrations make clear the difficulties of his previous paper, already noticed (this volume, p. 345).

Bernard[13] calls attention to the fact that the Galeodidæ, instead of lacking lateral eyes, have these organs transferred to the lateral surface, where they look downwards and forwards. Bernard thinks these organs are in process of atrophy, although one would not draw such conclusions from the rough figure of a section which he gives.

Simmons describes [14] the development of the lungs and tracheæ in spiders. The lungs develop on the posterior surface of the anterior abdominal appendages, and the appendages, sinking in form the anterior wall of the pulmonary sac. The tracheæ in their earlier stages are like the lungs, and later begin to penetrate the body. "From this it follows that the lung-book condition is the primitive one, the

[8] Johns Hopkins Hospital Bulletin, No. 40, 1894.

[9] Proc. Am. Soc. Microscopists, xv, 1894.

[10] Proc. U. S. Nat. Mus., xvii, p. 83, 1894.

[11] Tom. Cit., p. 43.

[12] Zeitschr. Wiss. Zool., lviii, 1894.

[13] Ann. and Mag. Nat. Hist., xiii, 517, 1894.

[14] Am. Jour. Sci., xlviii, 1894. Tuft's College Studies, No. 2.

tracheæ of the Arachnids being derived from it. And with these facts these is left no ground for those who regard the 'Tracheata' as a natural group of the animal kingdom."

HEXAPODA.—Schott has a monograph of palæarctic Thysanures in Vol. xxv of the Handlingar of the Swedish Academy, 133 species and varieties are enumerated, of which 9 are new. Seven plates illustrate the article, which cannot be neglected by entomologists.

A most interesting paper on the relations between attitude and color of European butterflies is given by Dr. Standfuss in the Zürich Society's Vierteljahrschrift for 1894.

HEXAPODA.—Scudder gives[15] a synopsis of the ringless locustarians of the tribe Ceuthophili. Six genera and 67 species are described.

MOLLUSCA.—Dall has monographed[16] the genus Gnathodon. From a consideration of large suites of specimens, and of young as well as old, and also from a study of the soft parts, he concludes that the genus is distinctly Mactroid in character. Ten species and varieties are enumerated.

Dr. Stearns[17] catalogues, with notes, a collection of shells from Lower California and adjacent waters, made by W. J. Fisher in 1876, together with those of other collectors. The paper has great value in matters of synonymy and geographical limits of species.

Apellöff records[18] the presence of several North American species of Cephalopods on the Norwegian coasts, and describes an example of *Eledone cirrhosa* in which the third right arm of both sides is hecotocotylized.

FISHES.—Gill shows[19] that our American pike perches must continue to bear the generic name Stizostedion, and that the European *Lucioperca marina* has more affinities with the other European species than with any American forms.

The same author also pleads[20] for the use of Pœciliidæ instead of Cyprinodontidæ, and discusses the nomenclature of the Lampreys, discarding his previously advanced name of Ammocœtes for the genus Lampetra. He further makes a family Mordaciidæ for the genus

[15] Proc. Amer. Acad. Arts and Sciences, xxx, 1894.

[16] Proc. U. S. Nat. Mus., xvii, 1894.

[17] Tom. Cit., 1894.

[18] Bergens Museums Aarbog for 1892, 1893.

[19] Proc. U. S. Nat. Mus., xvii, 1894.

[20] L. c.

Mordacia. In a fourth paper he discusses the subdivisions and relationships of the Salmonidæ and Thymallidæ.

E. D. Cope catalogues[21] a collection of 42 Fishes from the Rio Grande do Sul, Brazil. Of these, 17 are new. The species of Characinidæ and Siluridæ, 15 and 14 respectively, predominate.

BATRACHIA.—Miss Platt has published[22] her complete paper on the origin of the cartilaginous structures in the head of Nicturus, to which reference was made on p. 637 of the present volume.

Peter has studied[23] the vertebræ of the Cæcilians, and concludes that the evidence from these structures justifies the view of Wiedersheim (1879) and Cope (1884) that these forms should be assigned to Urodela. Regarding Cope's view, adopted by the Sarasins, that in Amphiuma we must recognize the ancestral form of the Cæcilians, Peter says, "there is indeed a certain similarity in the vertebræ of Apoda and Amphiumidæ, but no greater than exists between them and Siren, so that the view of this student is supported chiefly by developmental conditions."

MAMMALS.—Dr. E. A. Mearns describes[24] as new, *Sigmodon minima*, from New Nexico.

Dr. J. A. Allen points out[25] that the skull in Neotoma is extremely variable, and that "species" founded on certain cranial characters are frequently not of varietal rank.

[21] Proc. Am. Philos. Soc., xxxiii, 1894.

[22] Archiv für mikros. Anat., xliii, p. 911, 1894.

[23] Karl Peter. Die Wirbelsäule der Gymnophionen. Dissertation. Freiburg, 1894.

[24] Proc. U. S. Nat. Mus., xvii, 1894.

[25] Bulletin Amer. Mus. Nat. Hist., vi, 1894.

ENTOMOLOGY.[1]

Some Observations on the Distribution of Coccidæ.[2]—Being now in the midst of preparing a new list of the known Coccidæ, with notes as to food-plants, distribution, etc., I have thought it opportune to submit to you a few observations which seem to me to be of interest, relating to the geographical distribution of the several genera. In preparing these notes, I have, moreover, been moved by a lively hope that some of you who have so much unpublished information regarding this group of insects, may be induced to throw a little fresh light on points which are now obscure. More especially do I refer to the numerous undescribed species which must doubtless exist in the collections at Washington, information of which would so greatly help to fill up blanks now too apparent to those who read our lists with a critical eye.

The following genera, some of them not very well established, are monotypic according to present information.

Walkeriana Sign.; Ceylon.
Guerinia Sign.; Mediterranean Region.
Tessarobelus Montr.; New Caledonia.
Drosicha Walk.; Ceylon and China.
Llaveia Sign.; Mexico.
Nidularia Targ.; Europe.
Capulinia Sign.; Mexico.
Cerococcus Comst.; Arizona, California.
Xylococcus Löw; Austria.
Callipappus Guèr.; Australia.
Rhizœcus Künck., in hort (from Australia?).
Puto Sign.; Europe.
Tetrura Licht.; Europe.
Cryptococcus Dougl.; Europe.
Signoretia Targ.; Europe and Australia.
Fillippia Targ.; Europe.
Pseudopulvinaria Atkins.; Sikkim.
Vinsonia Sign.; West Indies, etc.
Physokermes Targ.; Europe.
Aclerda Sign.; France.

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.
[2] Read before the Entomological Society of Washington, Oct. 11, 1894.

Spermococcus Giard.; France.

Exærctopus Newst.; Channel Is.

Ericerus Guèr.; China.

Fairmairia Sign.; France.

Ischnaspis Dougl.; West Indies, etc.

Frenchia Mask.; Australia.

Of the above twenty-six monotypic genera, most of which are undoubtedly valid (seven, perhaps, might be questioned), it will be seen that just half are European, four are Oriental, four appear to belong to the Australian region, two are Mexican, two are marked as from the West Indies, etc., and one is from the arid portion of the United States.

Signoretia offers a singular case, the European species being represented in Australia by a form which Maskell separates from it only as a variety. Supposed endemic species of *Signoretia* from Australia and New Mexico prove to belong to *Pulvinaria* and *Bergrothia* respectively; and it is difficult to avoid the conclusion that *S. luzulæ* var. *australis* Maskell, from Australia, must be *S. luzulæ* which has been introduced and has varied from the type under its new environment. If so, the matter deserves the close attention of evolutionists.

It is curious that the common *Physokermes* of Europe has no representative here in America. We have two species of *Lecanium* on conifers, one in Canada, the other in California, but they are not like *Physokermes*.

So, also, we seem to have no representative of the subterranean European genera, *Aclerda*, *Spermococcus* and *Exærctopus*. Do our ants' nests never harbor such?

Fairmairia has a close ally in northern Mexico and New Mexico in *Ceroplastodes*—the latter with two species. A curiously similar case is offered by *Lichtensia*, which has one species in Europe and another in Vera Cruz, Mexico. The latter, one of the most beautiful of Coccidæ, from its brilliant yellow color, cannot be made the type of a distinct genus, though it is very different from its European congener.

Vinsonia and *Ischnaspis* (the latter near to *Fiorinia*) are common on cultivated plants in the West Indies, but the specimens offer no chance for the separation of even varieties. *Ischnaspis*, it will be noted, is the only monotypic genus of Diaspinæ.

The Monophlebinæ appear to be ancient forms, probably at one time more abundant than now. They have been found fossil both in Europe and America; and the existing genera are represented by comparatively few species widely scattered over the earth, after the manner of *Peripatus*. Thus, *Palæococcus*, to which the fossil species are assigned, has three living species, one in Europe, one in South America and one in New Zealand.

Ortonia has also three species; one from Natal, the other two neotropical.

Icerya appears to be neotropical, Oriental and Australian; and there is an allied genus or subgenus, which I hope Prof. Riley will soon describe, found here in New Mexico.

Porphyrophora is considered Palæarctic, but has its representative in America in *Margarodes*, with one West Indian and one Chilian species. *Cœlostoma* is confined to Australia and New Zealand, and thus forms an exception among the polytypic monophlebid genera; but *Monophlebus* is recorded from widely separated countries in the Eastern Hemisphere.

Gossyparia has five species, two Palæarctic, two Australian and one from New Zealand—truly a curious distribution!

Eriococcus is interesting. Six species are Palæarctic; Australia and New Zealand together have no less than sixteen, only one of which is common to both these countries, and then the Australian form is a distinct variety of a New Zealand species. No other species whatever are known except three from North America, two of which, *E. azaleæ* and *E. coccineus*, cannot well be native there. In the West Indies, where *Dactylopius* abounds, no *Eriococcus* has been ever seen.

Rhizococcus presents one Palæarctic species, three from Australia and six from New Zealand. We seem to have in this country two undescribed species, however.

Bergrothia, which is very near to *Dactylopius*, has one Palæarctic species; while two very nearly allied forms are found in New Mexico, and referred by me to the same genus. Still another is reported from Indiana, etc., but is undescribed.

Dactylopius seems to be rich in species in most parts of the world, but becomes rare and is supplanted by *Phenacoccus* in the northern parts of the Palæarctic region, such as England. The neotropical species are numerous, but the nearctic forms are singularly few, and (excepting introduced ones) all western. Mr. Coquillett has described them, and I have sent the description of a fourth to the printer. There are nine known species from Australia and eight from New Zealand; for the most part these differ in type from the neotropical forms, so that it might be proposed to place them in a distinct subgenus. The genus *Dactylopius*, as now understood, contains very divergent forms, but great difficulty is felt in any attempt to separate it into subgeneric groups.

Phenacoccus is rich in Palæarctic species, there being eleven or twelve, several recently (1886–1891) described. In strong contrast, we have but two endemic nearctic species, both western. There is not one from the neotropical region, but Australia furnishes two and New Zealand one.

Ripersia has five Palæarctic species, three from New Zealand and one from Australia. It was thought that we had none in America, but Mr. N. Banks has discovered a most remarkable maritime species, the description of which now awaits publication. It is very closely allied to one (*R. rumicis*) from New Zealand.

Coccus has three races, perhaps not very distinct as species, from the warmer parts of North America, extending northward in the Rocky Mountain Region. *C. agavium* may be referred to a distinct genus, *Gymnococcus* of Douglas, which should be added to the list of monotypic genera above. Its native country is unknown.

Kermes has several Palæarctic species; one Ethiopian, not yet described; one Australian; and a problematical number nearctic. In the last mentioned region only a single species has been described, but others exist and sorely need attention. No species are neotropical.

Orthezia is doubtless an old form, and certainly a very interesting one. The number of Palæarctic species is a matter of dispute, but there are not over half a dozen. Four are nearctic; and here it may be mentioned that Prof. C. H. T. Townsend has just discovered a beautiful new one in Sonora. Two are neotropical, both described by Douglas. None were known from the Oriental region, until the other day Buckton described one from Ceylon. Not one occurs in Australia or New Zealand.

Prosopophora was described as lately as 1892, but already we know four species, one neotropical, one nearctic (New Mexico), and two from Australia.

Tachardia has four American species, one still awaiting publication. There is, also, one from the Oriental region, while three are Australian.

Pulvinaria is rich in Palæarctic species, but the endemic nearctic species are only three or four! Four are neotropical; two (one undescribed) Oriental; four Australian; and one is from the Sandwich Is. The absence of native species in New Zealand is noteworthy.

Ctenochiton, with eleven species, and *Lecanochiton*, with two, are strictly confined to New Zealand; and may be set off against the numerous extraordinary gall-making forms of Australia, which are wanting in the New Zealand fauna.

Inglisia has five New Zealand species, and until last year was supposed to be confined to that island. But in 1893 Mr. Maskell described one from Australia, while this year I have described a species from Trinidad in the neotropical region.

Ceroplastes has its metropolis in the neotropical region, with thirteen supposed species, some of the most doubtful validity. One only is native in the nearctic region, and that to the south (New Mexico and Northern Mexico), as *C. rusci* is in Europe. One is Ethiopian, two Australian, and two Oriental. Of the last mentioned, *C. ceriferus*, which produces the Indian White Wax, appears to be also widely distributed in the neotropical region. Can it be a survival in both regions, like the tapir—though not, like that, differentiated into species?

Lecanium presents nearly 90 species, several of which, however, may not be valid. The *Eulecanium* series is abundant and widely distributed in the Palæarctic and nearctic regions, but I do not know a single *Eulecanium* from elsewhere. In the tropics the *Bernardia* section, with few but very destructive species, takes its place. The neotropical species, when we eliminate those introduced from elsewhere, amount to only eight, only one of which (*begoniæ*) is a *Bernardia*, and the endemic character of that is a matter for serious doubt. But who shall say that *L. oleæ* and *hemisphericum*, which belong to *Bernardia*, are not neotropical, since they are now so widely spread that their native country cannot be learned? The Oriental species, so far as endemic, are but six, while three peculiar forms are recognized as endemic in Australia. In New Zealand, Mr. Maskell has found but one new species, and that is extremely near to *L. oleæ*.

The above notes will suffice for the purpose intended, though many genera, including the Diaspinæ, are passed over. Defective as our knowledge is, we seem to see some glimmering of light, which should spur us on to further discoveries which will give a sound foundation to our knowledge of Coccid distribution.—T. D. A. Cockerell, New Mex. Agr. Exper. Station.

Securing Moth's Eggs.—J. B. Lembert describes[3] the following method of securing eggs of moths: "When I take an *Arctia ornata* ♀ and she is ready to lay eggs, the moment she shows signs of being stupefied in the cyanide bottle, I take her out, close the wings over her back, and place her in a paper envelope; as soon as she revives she will commence to scratch the paper with her legs; I then shake the envelope, and if she has given up some eggs, I take them out, give her

[3] Can. Entomologist, June, 1894.

another dose of cyanide fumes, and when she revives a second time I have found as many as 125 eggs in the paper." The method has also been successfully used in securing the eggs of butterflies.

American Species of Seira.—In a paper on the American species of the Thysanouran genus Seira[4] Prof. F. L. Harvey describes *S. mimica* n. sp., which resembles *S. nigromaculata* Lubbock, but differs in the color and the arrangement of the color patches. It is found in warm, dry situations about buildings. *S. bulkii* Lubbock was also found at Orono, Me., under conditions which indicated that it was indigenous.

Kentucky Orthoptera.—Prof. H. Garman publishes, in the Sixth Annual Report of the Kentucky Agricultural Experiment Station, a valuable list of the Orthoptera of that State. In introductory paragraphs he makes the following remarks which are of general biological interest:

"The fauna of the State presents no well-marked features of its own. The eastern half of the State evidently forms part of an eastern zoological region, while the western half is as evidently southern in general character. The species occurring within our limits fall under five categories, as follows: (1) Those which occur everywhere in the United States, such as *Gryllus abbreviatus, Hippiscus rugosus, Chortophaga viridifasciata, Pezotettix bivittatus, P. femurrubrum* and *P. atlanis.* (2) Those which belong to the eastern region, represented by *Acridium alutaceum, A. rubiginosum* and *Paroxya atlantica.* (3) Southern species, such as *Schistocerca americana, Anisomorpha buprestoides* and *Stagmomantis carolina.* (4) Western species, such as *Pezotettix differentialis* and *Mestobregma cincta.* (5) Cave species, of which we have three.

"In Eastern Kentucky the fauna is, as a whole, eastern and northern in character, rather than southern, probably because of the greater elevation above sea level of this part of the State. The southern species show a marked increase in abundance in this section as one approaches the southern boundary of the State. Here the northern limit of the Austroriparian region may be said to coincide with the boundary between Kentucky and Tennessee, and so continues to the headwaters of the Barren River, where a sharp northward extension occurs, bearing gradually northwestward, and following along the eastern limits of our western coal fields to enter southern Indiana and

[4] *Psyche*, Nov., 1894.

Illinois. I could not perceive any very decided southern features of fauna or flora at Campbellsville and Greensburg, near the headwaters of Green River. At Bowling Green and Glasgow Junction the southern character is decided. At Elizabethtown, farther north and east, the fauna and flora do not appear to be very different in relative abundance of species from those of the region about Lexington. The eastern limit of the northward extension of the Austroriparian region would thus appear to follow approximately the meridian marking the 86th degree of longitude west from Greenwich, and accompanies a fall in altitude to about 500 feet above sea level, the blue-grass region to the eastward being in the neighborhood of five hundred feet higher than the region west of Leitchfield. This western region is marked not only by an increased abundance of southern Orthoptera, but quite as decidedly by its other insects, its plants, and its vertebrate animals. Among Lepidoptera, *Callidryas eubule* and *Euthisanotia tamais* become noticeable. The water moccasin (*Ancistrodon piscivorus*) and the shining bass (*Centrarchus macropterus*) appear. There is a decided increase in the numbers of such birds as the tufted titmouse, summer redbird and scarlet tanager.

" We find here the spider-lily (*Hymenocallis occidentalis*), the American aloe (*Agave virginica*), the willow oak (*Quercus phellos*), the water-locust (*Gleditschia aquatica*) and the Mississippi hackberry (*Celtis mississippiensis*).

"Among the Orthoptera found in this end of the State two are worthy of special mention because their occurrence is in some respects exceptional. *Mestobregma cincta* is recorded by collectors from Colorado and Wyoming. Dr. Cyrus Thomas obtained examples from Southern Illinois. I recently collected specimens at Glasgow Junction and Bowling Green in this State. I have no record at hand relating to its occurrence in regions between these widely separated eastern and western habitats. The second species is *Pezotettix differentialis*, the

FIG. 1. *Pezotettix differentialis.* After Riley.

large olive grasshopper so common in the northwest. It appears to be one of a relatively small number of northern species whose distribution is extended to the southward by the influence of the Mississippi River. The species is one of the commonest Illinois grasshoppers. It is common locally in Western Kentucky, but has not been seen eastward.

"The peculiar cave Orthoptera of Kentucky are deserving of a word in this connection. The species are all wingless crickets with greatly enlarged hind limbs for leaping, and excessively lengthened antennæ. All have eyes of the usual size, and without exception live by preference near the cave mouths. The species most completely adapted to life in the caves is the cave cricket (*Hadenœcus subterraneus*). It is a large brown creature, so fragile that it is almost impossible to get perfect specimens. Specimens taken alive from the caves in summer, invariably died, probably because of the sudden change of temperature. I am disposed to think they could be removed in cool weather without difficulty. I have never seen this species anywhere but in caves. It occurs in all our larger caverns, however. A second species (*Ceuthophilus stygius*) resembles the preceding in general form, but has the legs and antennæ less lengthened, and is spotted with black. It is closely allied, both in structure and color, with species occurring out of doors under rocks. It is more closely confined to the region near the entrance of caves than is *Hadenœcus subterraneus*, but appears not to leave the caves. These two are the only cave crickets I have seen in Kentucky, but Dr. A. S. Packard, of Brown University, has obtained a third, which he says is associated in caves with the preceding. I have a number of specimens that agree perfectly with his description of this cricket, but they were found in every case under rocks or logs out of doors."

Coleoptera of Lower California.—At a recent meeting of the Cambridge Entomological Club, Dr. G. H. Horn discussed this subject.[5] He remarked "that about 800 species were now known to him from the region which may be divided into four faunal provinces: (1) The San Diego fauna extends down the larger part of the west coast. (2) The fauna of the highlands (so far as collected, *i. e.*, north of the middle of the State) seems to be related to that of the Central California Valley. (3) The fauna of the east coast extends through Arizona northward, and eastward down the Rio Grande. (4) The fauna of the extreme southern end of the peninsula is truly tropical in character."

New Fossil Beetles.—Mr. S. H. Scudder calls attention[6] to a

[5] *Psyche*, Nov., 1894.

[6] *Psyche*, Nov., 1894.

new family of fossil beetles established by Schlechtendahl in a recent paper on the fossil insects of Rott on the Rhine (Abh. Naturf. Ges. Halle, XX). It is named Paleogyrinidæ, and the type shows a combination of the characters of Gyrinidæ and Dytiscidæ. "Extinct types of insects of as high a grade as families are extremely rare in the tertiaries."

Reversal of Position in Insect Embryos.—Dr. G. A. Chapman summarizes[7] his own and others' observations on the phenomena associated with the change of position that occurs in the young lepidopterous larvæ within the shell before hatching. "In all cases the larva first appears on the surface of the yelk-mass as a flat plate, of which the central line is the middle of the ventral surface, and the margins are the two sides of the dorsum, still far apart. These margins, however, rapidly curl in and, at the head and tail, the young embryo soon has the cylindrical form we associate with the larva, but centrally, there remains a wide opening through which the mass of the yelk is continuous with that portion of it contained in a central cavity of the larva; this central cavity is the future alimentary canal, not yet provided, however, with any opening towards either the head or the tail. The communication between the intestinal cavity and the yelk sac gradually becomes smaller, and portions of yelk leave the sac and pass into the intestine, and contribute to the growth of the embryo. During this period, it is easy, in flat eggs like those of the Pyralides, Tortrices, Limacodes, etc., to see the embryo curled around a greater or less portion of the yelk sac, with its ventral surface towards the margin of the egg, and its dorsal surface (aspect rather than surface, as the surface is still broken by the umbilical opening) applied to the yelk sac. There is a little variation in the degree to which the yelk disappears before the umbilical opening closes, but when this takes place the larva forms a horseshoe or circle, with the venter towards the shell wall and its anterior and posterior extremities in contact. At this period, also, there are a varying number of globules of yelk free in the egg cavity around the larva; whether these are set free by the movement of the larva that now takes place, or still later by the jaw action of the larva, I am not sure, but after the movement has taken place the young larva swallows these; this swallowing of the remaining yelk may indeed be regarded as a first step towards eating its way out of the egg. Before the closing of the umbilical opening, the embryo may be regarded as an appendage to the yelk sac, attached thereto by its

[7]Entomologist's Record, Oct. 15, 1894.

PLATE XXXIV.

From photograph of Stalactite 60 centimeters long and 20 years old; formed between the years 1873 and 1893 on the ceiling of a reservoir roof arch at Bayreuth, Bavaria. Scale $\frac{1}{7.73}$

dorsal aspect. As soon as the opening closes, however, the young larva is truly a young larva, possessing no organic connection with the other egg structures. The first use it makes of its liberty is to bend the tail forwards and, as it were, creep up its own ventral surface, assuming in this process an S or pot-hook shape, until at length its position is reversed, the dorsum being now along the circumference of the egg and the venter being central. The head and tail sometimes merely meet in the (flattest eggs), sometimes slightly overlap, whilst, in the dome-shaped eggs the head so overlaps as to take very often a central position in the vertex of the egg, forming a dark spot there, as in Acronycta, Skippers, and many others.

"The essential importance of this observation is, that it shows that the embryonic position of the nervous system is the same in insects as in vertebrates, and since it must, therefore, be identified also in the mature animal, it follows that the venter of insects corresponds anatomically with the dorsum of vertebrates, and *vice versa.*

"As regards the actual change of position itself, and the position afterwards taken by the larva, it seems to me that the important point is that the larva whilst still truly an embryo, that is, whilst still attached to the yelk and egg structures, has the venter outwards, and the dorsum towards the center of the yelk or egg; but when it becomes free it is no longer an embryo, it moves how it likes, and through the position it takes up seems to be very uniform throughout each species and and even throughout whole families; still this has little, if any, embryological significance. I have frequently seen larvæ making this S movement, and though I have called it 'creeping up its own ventral surface,' it goes on slowly, without any apparent voluntary or even movements, and appears to be due to the mere force of the growth and development of the larva. Sometimes it seems as if the lengthening of the larva led to the extremity of the tail impinging against the side of the egg-shell and instead of sliding onwards, being caught and bent up. It is associated no doubt with the completion of the growth of the dorsal surface previously defective by the large umbilical opening, and now more abundant in proportion to the ventral surface. It proceeds slowly and steadily, so that usually some progress may be noted in five or ten minutes.

"Very shortly after, what appear to be voluntary movements of swallowing take place, the remainder of the yelk disappears, and the remaining fluid is either absorbed by the larva through the skin, or evaporates through the shell; the tracheæ become visible by getting filled with air, and the larva begins the process of eating through the shell."

Cecindelid Larvæ.—H. F. Wickham describes[8] the larva of Cecindela as "a somewhat elongate, whitish grub, with a broad, metallic colored head and prothorax, and a large hump, bearing two hooks, on the fifth abdominal segment. They excavate holes in sunny spots and lie in wait for prey, with the head closing up the mouth of the burrow; when an insect comes within reach, it is seized by the long jaws of the larva and the juices extracted. I am now rearing larvæ of *C. limbalis* Klug, which I dug from holes in a clay bank on the fifteenth of April. They are easily kept in little tin boxes with damp earth, and feed readily on soft-bodied larvæ of wood-borers. The pupa is figured by Letzner and is represented as bearing on the fifth abdominal dorsal, two spines corresponding to the hooks on the same segment in the larva."

Social Economy of the Hive Bee.—In a recent presidential address before the Biological Society of Washington, Dr. C. V. Riley described the social organization of the hive bee.[9] "Each bee," he said, "labors for the good of the commonwealth of which it is a member. Of them it might well be said:

Salus rei publicæ lex.

It is the welfare of the colony which directs the actions of all, and not the will of the queen. Indeed, it would seem that the latter performs her important function—that of supplying the hive with eggs—only when the workers will it, their own condition of prosperity as regards stores, or their anticipations of the future needs of the colony as regards population, causing them to supply the queen liberally with food rich in nitrogen—a partially digested substance, or a gland product, or perhaps, a mixture of both, which she alone cannot produce, yet without which any considerable production of eggs is an impossibility. As Evans remarks:

'The prescient female rears her tender brood
In strict proportion to the hoarded food.'

"We must, then, credit the industrious and provident workers with the chief influence in shaping the policy of the hive. They are the *servum pecus*—the living force—of the colony. And to the end that order and efficiency of effort may prevail, they have, we find, a marked division of labor. In the normal condition of the hive the young workers care for the brood—a labor which they take upon themselves

[8] Can. Entomologist, June, 1894.
[9] Insect Life, September, 1894.

within two or three days after issuing from the cell. The glands which secrete a part of the food required by the developing larvæ are active during the earlier part of the life of the worker. Later, these nurses become incapable of doing their work well as the gland system becomes atrophied. When a few days old they take short flights, if the weather favors, but seldom commence gathering stores before they are fifteen days old. Wax production is more essentially a function of the workers in middle life, and it is particularly noticeable that those bees fashioning the wax into combs are principally of this class. Many of those acting as foragers do, however, secrete wax scales, which are doubtless, in the main, utilized. Among the outside workers and hive defenders some bring honey only on certain trips or for a time, others honey and pollen, others water, and yet others propolis or bee glue to stop up crevices and glue things fast. Meanwhile, some are buzzing their wings at the entrance to ventilate the hive, and others are removing dead bees, dust or loose fibers of wood from the inside of the hive or from near the entrance, or are guarding this last against intruders, or perhaps driving out the drones when these are no longer needed."

Notes on New Hampshire Lepidoptera.—Mr. James H. Johnson, Pittsfield, N. H., in a letter to the editor of this department, recently, included the following notes on Lepidoptera in his region: "I have one specimen of *Colias interior* from Charlestown. This, I notice, Maynard calls 'accidental at Waterville, Me.' One specimen of *Debis portlandia* I took at Webster, one *Limenitis arthemis* (*proserpina*) at South Sutton, one *Thanaos brizo* and several of *Neonympha eurytris* at Charlestown. I have a pair of the *Chionibas jutta* from Orono, Me.

"Of the moths, I have one each of *Catocala relicta* and *C. relicta* (*bianca*) one pair of *Eacles imperialis*. These three were taken at South Sutton, Va. I find *Eucronia maia* is quite common in one place here at Pittsfield. Have not noticed it elsewhere. I see Dr. Harris called it rare in Mass."

Hemiptera of Buffalo.—One of the most valuable of recent faunal lists has just appeared in the Bulletin of the Buffalo Society of Natural Sciences (Vol. V, No. 4). It is "A List of the Hemiptera of Buffalo and Vicinity," by Edward P. Van Duzee. It "enumerates all the described Hemiptera to and including the Jassoidea known to inhabit the vicinity of Buffalo, N. Y. The limit of 70 miles, adopted by

Mr. David F. Day in his Catalogue of the Plants of Buffalo and Vicinity, has been followed by the author * * * but nearly all the species have been captured within a radius of 20 miles of this city." The Psyllidæ, Aphididæ and Coccidæ have not been included in the list which enumerates 378 species, and mentions 25 undescribed species that have been found.

In the same Bulletin Mr. Van Duzee publishes Descriptions of some New North American Hemipterous Insects, belonging to the following genera: Idiocerus, Platymetopius, Allygus, Deltocephalus, Athysanus, Entettix, Scaphoideus, Thamnotettix, and the new genera here characterized, Tinobregmus and Xestocephalus.

ARCHEOLOGY AND ETHNOLOGY.[1]

The Age of Certain Stalactites.[2]—The fact has been recognized for some time among scientists that the formation of stalactites, under favorable circumstances may take place in a relatively short time.

Nevertheless, observations upon the exact period required for the growth of given examples have been rather rare, for while there has been abundant opportunity to compute the age of stalactites at railway bridges and tunnels, the various dangers which beset these delicate growths in such places have generally put a considerable limit to their age, and deprived them of conspicuous size. It may, therefore, be of interest to state an instance where not only the time of growth but also the exact size of a stalactite can be given with absolute precision.

In the year 1873 the city of Bayreuth (Bavaria) built a reservoir for drinking water three kilometers southwest of the town. This so-called Lasser Reservoir is built in a *Keupersand* soil which contains exceedingly slight traces of lime. The water used in the basin comes out of the *Keuper*, (the uppermost of the three subdivisions of the Triassic period), and likewise contains lime, though in very small quantity. At the point shown in the illustration a spot on the ceiling of the arch (built across the tank to protect the water from pollution H. C. M.) stalactites of remarkable size had formed in 1893. Supposing that they had begun to form by the infiltration of surface water through the arch immediately upon its completion in 1873, they could not have been more than twenty years (1873–1893) old, and as the photograph recently taken from nature shows their length to be between 60 and 80 centimeters, they must have grown on an average of from 3 to 4 centimeters a year. The reservoir was first used in 1874, the tank under the arch remaining full of water until the present year, when in the course of the summer, the water was drawn off for repairs, and an opportunity afforded of observing and detaching some of the stalactites. A great number of the finest specimens were broken through the ignorance of workmen. In a damp walled chamber adjacent to, though not included in the area of, the basin, hung whole rows of stalactites from 20 to 30 centimeters long. These were extremely fragile and very difficult to remove without breaking.

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

[2] Translation from the original German.

A careful examination of the structure of the reservoir building showed that the stalactites must have formed as follows:

The reservoir's arched roof from which they hung was built of bricks laid in cement (probably the kind known in America as German Portland, H. C. M.). Slight fissures had formed in the cement through which the water of the surface (rain water H. C. M.) had trickled. This down trickling water had dissolved portions of the cement, and then evaporating, had first caused a formation composed of particles of lime dissolved from the cement. This formation was the starting point of the stalactites. On it had been precipitated very fine particles of the reservoir water, leaving after they had evaporated a further residuum of lime upon the already existent pendant.

This view is strengthened by the fact, that since the building of another more recent (so-called Fuchstein) reservoir 3 kilometers west of Bayreuth, stalactites 2.5 centimeters long have shown themselves hanging in the same way from the cement ceiling of the roofing arch. Moreover, if indentations are scratched in the cement, pendent accumulations of lime are soon formed, which, however, are not hollow in the middle like the stalactites.

Finally, as the result of an experiment, the following method for producing stalactites artificially, may be mentioned:

Take a common hectoliter cask. Make a hole in its bottom. Plug this hole with a wooden plug so wound with tow that the water may trickle through it in very small quantities. Around the end of the plug on the outside of the bottom of the cask, spread cement (German Portland cement, H. C. M.) in which a slight fissure should be left. Then fill the cask with the water containing lime in solution and place it in the open air. Hang a piece of tow on the fissure in the cement so that the water trickles upon it, and stalactites will form very rapidly. In this way I made a stalactite 5 centimeters long inside of 8 weeks.

FRANZ ADAMI.

Bayreuth, September 30, 1894.

Note by the Editor.—A very hard crust of stalagmite, covering a loam bed with rhinoceros teeth and human relics, overlaid the cave floor of Kents Hole (near Torquay, England) in which Mr. McEnery says (1825) that he found in no instance breaches or openings, "but one continuous plate of stalagmite diffused uniformly over the loam." Schmerling who (in 1832) used to climb down into Engis Cave (near Liege, Belgium) by a rope tied to a tree, and after a long crawl, stand in the mud to superintend by torchlight, workmen digging in a wet hole, had to break through a stalagmitic floor hard as marble and cut five feet into a breccia nearly as hard, to find the famous skull now in the University of Liege.

But the presence of these crusts, though serving satisfactorily to separate diverse accumulations on cave floors one from another, is no longer regarded in Europe as evidence of the great age of relics so entombed.

In the Wyandot Cave (right bank of Blue River, 5 miles from its mouth in the Ohio, Crawford Co., Indiana) a hole has been artificially battered in the side of one of the innermost large stalactites called "The Pillar of the Constitution,"and it appeared from the observations of Professor Collet (Ind. Geolog. Survey, 1876–77–78, p. 467) and Mr. Hovey who found (as I did in June, 1894) granite pebble hammerstones lying in a mass of splinters near the hole, and Mr. H. W. Rothrock, who (in 1877–78) found besides hammerstones, a deer horn "pick" or prying tool, close by, that Indians had battered out the hole with the stone hammers to get fragments of carbonate of lime for some purpose (possibly trinket making) not yet determined.

A crust of stalactite 10 inches thick has since crept over the bruised edge of this unique quarry, and Mr. Hovey thought (Celebrated American Caverns, p. 139) that "at the known rate of increase, it must have required 1000 years for the wrapping to attain its present thickness of 10 inches, and that length of time has, therefore, elapsed since this 'alabaster' quarry was worked."

Professor Adami's above statement which omits, however, a chemical analysis of the cement referred to, is one of the sort of valuable observations which has shaken faith in the worth of all age tests based on stalagmite or stalactite. If for a thousand years the still standing forests have helped dampen the roof of Wyandot Cave, if rain has kept falling at an equal rate all that while, and if water always equally charged with lime has gone on trickling through the ceilings ever since, then what happened in twenty years to rain water and cement at Bayreuth might have taken fifty or a hundred times as long to happen to rain water and limestone in Indiana. But we can hardly imagine a case where in a cave care enough would have been taken, and time enough spent in measuring the yearly increment, or still more where the inferred conditions of uniformity reaching back into a little known geological past, could have been weighed.

H. C. MERCER.

Indians Mining Lead.—Mr. Benjamin Pursell, of Kintnersville, Bucks County, Pa., told me in September, 1891, as a well known story in the Delaware Valley, that Indians in the last century had shown members of the Ridge family, then living on Ridge's Island, lead ore in situ, at a spot never since discovered in the neighboring hills.

More definite still is the lead story of New Galena, Bucks County, Pa., at third hand. Somewhere in the middle of the century Elijah and Abraham Campbell, of Plumstead, told John M. Proctor, now of Blooming Glen, who wrote me in December, 1891, that straggling Indians coming to hunt along the north branch of the Neshaminy, between 1790 and 1808, had often taken them as boys to a place near the mouth of the "Hartyhickon" (now the property of Mr. Arthur Chapman). There they disappeared in the woods to return with their arms full of lead, with which they made bullets.

I took these for local tales till I was surprised to hear J. M. Kessler, at Hummel's Wharf, Snyder County, Pa., tell me the same story, while pointing to the hills across the Susquehanna as its scene. But I came nearest of all to the legend when Reuben Anders, of Little Wapwalopen, Luzerne County, Pa., gave me it first hand. He had seen the Indian who had spent the night with his grandfather and offered to show him a mineral wonder on a hill called Councilkopf. Though the latter was afraid to follow the red man alone, one Harman had gone hunting with two others, who when bullets had given out had gone into the woods and returned with loads of lead. If untrue, it is hard to see why this lead story has so seized the popular mind. But when we realize, as I am informed, that lead rarely, if ever, occurs pure in nature, but as galena, which, if mixed with lumps of limestone, requires about 1200 degrees (Centigrade) of heat to smelt by drying out the carbonic acid and removing the sulphur, it is to be doubted whether, given the galena, any such offhand bullet-making in the woods could ever have taken place.[3]

Squier and Davis found galena ornaments in ancient Ohio tumuli. Mr. Clarence B. Moore showed me a lump excavated by him from a St. John's River (Florida) mound, and modern Sioux ornament their catlinite pipes with lead, but no digging has yet proved that mound

[3] Some specimens of galena, recently obtained through Mr. Alfred Paschall, from the prospective mine now working in the bed of the North Branch of the Neshaminy, on the farm of Henry Funk (New Britain Township, Bucks County, Pa.), would not melt in a red-hot crucible, but splintered into fine fragments, as did other fragments when held directly in the bellows fire.

builder or Indian in pre-Columbian times regarded galena as other than a hard, glittering stone to be pounded or rubbed into trinkets.[1]

Still we know that the Rhode Island Indians very soon learned the art of pewter casting from Roger Williams' colonists, and the question therefore, is, had Indians in Eastern Pennsylvania by 1780–90 learned from white men how to smelt bullets from galena for their newly acquired guns?

Whether or not these lead tales furnish us with an archeological clue of importance, they seem less strange than the story told me on July 12, 1893, by Charles Keller (now 84 years old), of Point Pleasant, Bucks County, Pa., as related to him sixty years ago by his father, Christopher Keller. About the end of the last century Peter Keller, Christopher's brother, had refused to do some iron work for a band of Indians at his blacksmith shop, on Tohickon Creek, above Stover's mill (the present Redding Meyers farm,) about six miles above its mouth on the Delaware River. When he pleaded as an excuse that his supply of charcoal was exhausted, the Indians went into the forest and after nearly a day's absence returned with a basket full of "stone" (anthracite) coal, with which he did the job.

H. C. MERCER.

[1]After the present pages were written, Mr. Walter Chase, of Madison, Wisconsin, showed me a small figure of a turtle of cast lead found by him at a surface Indian camp site in 1889 on the shore of Lake Wingra, two miles southwest of Madison. Dr. Hall, of Madison, had another plowed up by a farmer in 1891, with a stone axe and four or five arrowheads, from an effigy mound shaped, itself, somewhat like a turtle, on the shore of Lake Mendota, near Madison. Two perforated discs of cast lead have also been found by farmers in Dare County, Wisconsin, and are now in the possession of neighboring collectors. Galena occurs in Southern Wisconsin in small, loose masses in a very pure state.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, November 7.—The following paper was read: Professor George Lincoln Goodale, An account of the Ware Collection of Blaschka Glass models of Flowers in the Harvard University Museum. With illustrations.

November 21st.—The following paper was read: Dr. George A. Dorsey, "The Peruvians, prehistoric and modern." Stereopticon views were shown.

Samuel Henshaw, *Secretary.*

New York Academy of Sciences, Biological Section, October 22.—The following papers were read: Professor N. L. Britton, and T. H. Kearney, Jr., "On a Collection of Texano-Mexican Plants,"—new species and altitudinal notes; Professor E. B. Wilson, "The fertilization and polarity of the egg in *Toxopneustes lividus.*" The study of extensive series of sections fixed by sublimate-acetic and stained by Heidenhain's iron-hæmatoxylin fails to give any evidence of a "quadrille of the centrosomes." The archoplasm is wholly derived from, or formed under the influence of a substance derived from the spermatozoon and situated not at the apex but in or near the middle-piece. Regarding polarity, the continuous observation of a large series of living eggs shows that the definitive egg-axis has no constant relation to that passing through the excentric egg-nucleus but may form any angle with it. The first cleavage passes approximately through the point of entrance of the spermatozoon as described by Roux in the frog. Dr. Bashford Dean, "On the breeding habits of Lepidosteus from observations at Black Lake, N. Y., May, 1894;" Professor H. F. Osborn, "On the Proceedings of the Biological Section of the British Association."

November 12.—N. L. Britton, "Problems in Plant Evolution," noting from the side of Paleobotany the centralized position of Algæ and the probable affinities of pteridophytes and bryophytes. G. N. Calkins, "A little known phenomenon in the life history of *Stentor coeruleus.*" The free swimming Lieberkuhnina of Bütschli was shown to be (as Claparède and Lachman had earlier believed) an embryo *Stentor.* H. G. Dyar, "A classification of Lepidopterous larvæ according to setiferous tubules," giving data for the establishment of six super-families. S. F. Clark, "The breeding habits of Alligator." H. F. Osborn, "The skull structure of Titanotheres."

BASHFORD DEAN, *Rec. Sec.*

National Academy of Sciences.—The following papers were read at the meeting in New Haven, Oct. 30., Nov. 1.—An indirect experimental Determination of the Energy of Obscure Heat, William A. Rogers; Determination of the Errors of the Circles of an electrotype copy of Tycho Brahe's Altitude Azimuth Instrument now in possession of the Smithsonian Institution, William A. Rogers; The Winnebago County, Iowa, Meteorites and the Meteor, Hubert A. Newton; Literal Expression for the Motion of the Moon's Perigee, George W. Hill; Atmospheric Dust and Aqueous Precipitation in Arctic Regions, William H. Brewer; Further Researches on the Polar Motion, Seth C. Chandler; The Relation of Gravity to Continental Elevation, Thomas C. Mendenhall; The Legal Units of Electrical Measure, Thomas C. Mendenhall; On derived Equations in Optics, Charles S. Hastings; On a method of eliminating Secondary Dispersion, using ordinary silicate Glasses only, Charles S. Hastings; The Chemical Nature of Diastase, Thomas B. Osborne, (Introduced by S. W. Johnson); Some Features in the Development of Brachiopods, Charles E. Beecher, (Introduced by O. C. Marsh); On the Presence of Devonian Fossils in Strata of Carboniferous Age, Henry S. Williams, (Introduced by O. C. Marsh); On the influence of Insolation upon Culture Media, and of Desiccation upon the Vitality of the Bacillus of Typhoid, of the Colon Bacillus, and of the Staphylococcus aureus, John S. Billings; Report on Photographing Meteors, William L. Elkin, (Introduced by H. A. Newton); Biographical Memoir of F. V. Hayden, Charles A. White; Geographical and Bathymetrical Distribution of the Deep Sea Echinoderms, discovered off the American Coast, north of Cape Hatteras, A. E. Verrill; On the effect of Pressure in broadening Spectral Lines, A. A. Michelson; Remarks upon the progress of work upon a Handbook of the Brachiopoda, James Hall; Note upon the Occurrence and Distribution of the Dictyospongidæ in the Devonian and Carboniferous Formations, James Hall; Infra red Spectrum, S. P. Langley; On a certain Theorem in Theoretical Mechanics, J. W. Gibbs.

The Biological Society of Washington, December 1st.—The following communications were read: Mr. B. T. Galloway, "The Physiological Significance of the Transpiration of Plants." Mr. F.

H. Knowlton, "The Amount of Water Transpired by Plants," Prof. B. W. Evermann, "The Redfish of the Idaho Lakes." Mr. Charles T. Simpson, "On the Validity of the Genus Margaritana."

FREDERIC A. LUCAS, *Secretary.*

1896.