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PARASITIC BACTERIA AND THEIR RELATION TO SAPROPHYTES.[1]

BY THEOBALD SMITH.

PARASITES, whether they be animal or vegetable, have certain characters in common which are due to their relation to their host rather than to their own intrinsic organization. I shall endeavor to point out a few of those which may be observed among bacteria parasitic on animals. Since they usually give rise to well-defined diseases, they are also called pathogenic bacteria, or more popularly, disease-germs. Almost all pathogenic forms may be considered true parasites, at the same time all truly parasitic forms have been found pathogenic.

There are certain external regions of the animal body quite uniformly the seat of specific bacteria. They are the skin and alimentary canal. Observations have shown that in the different sections of the digestive tract different bacteria are found. To some of these a digestive function has been attributed, the power of peptonizing albumens, and thus facilitating their absorption. The bacteria inhabiting the mouth are numerous, and some are found quite constantly, such as the well-known *Leptothrix buccalis*. A microcobe has also been found which some years ago was erroneously regarded as identical with the cholera bacillus. The mistake was pointed out by demonstrating its inability to grow upon gelatine, which the cholera germ readily does. I have repeatedly found in my own saliva the same liquefying coccus

[1] Read before the Biological Society of Washington, D. C., December 11, 1886.

greatly preponderating over other species, although months elapsed between consecutive examinations.

Such bacteria cannot be considered strictly parasitic. It is true that they have adapted themselves to conditions which are now necessary to the continued existence of many of them, yet, if we draw the line at which saprophytic phenomena end and parasitic begin, they are not true parasites. For they do not invade the living tissues to meet the resistance which the living cells interpose, but live upon dead organic matter present upon the skin, in the mouth, and the digestive tract in general.

This adaptation to certain media is common to many micro-organisms. The juice of the grape becomes the habitat of a saccharomyces (*Cerevisæ*) which converts the glucose into alcohol and carbonic dioxide. When this fermentation has ceased the bacterium aceti oxidizes the alcohol into acetic acid. When the medium is too acid the bacterium aceti cannot exercise its fermenting power, and another saccharomyces (*Mycoderma*) first reduces the acidity of the liquid by oxidation. Examples may be multiplied in illustration of this fact that bacteria as well as fungi select certain media as most favorable to their growth.

It now and then occurs that bacteria not strictly parasitic may prove pathogenic in setting up fermentations and decompositions in the alimentary canal. The substances thereby produced are absorbed, and act as chemical poisons. It seems very probable that our information of digestive derangements will be made more precise and better methods of relief applied when more attention has been bestowed upon the bacteriology of the digestive tract. Under certain conditions the *Leptothrix buccalis*, the most common microbe in the mouth, may become in a sense parasitic. When the enamel of the teeth has been removed by acids formed in the mouth during the fermentation of food, this microbe causes the slow disintegration known as caries by invading the dentinal tubules and the pulp-cavity. Now and then bacteria which carry on a harmless existence in one place may become very virulent in others. A few years ago Dr. Sternberg found that rabbits died within a few days after the injection beneath the skin of some of his saliva. This virulence may last for years. For it is extremely difficult to dislodge a microbe from a place which it finds conducive to its vital activity. Harmless in the human mouth, it is able to multiply in the body of one of the higher mammals, to act as a true parasite and destroy life. This may explain the occasionally poisonous bites of animals. The sputum in pneumonia has been found equally fatal to rabbits. But here we are confronted with the important but still unsettled question whether the pathogenic microbe in the sputum is not the cause of the pneumonia.

Whether we shall ever find bacteria within the organs, in the blood and lymph-channels of the animal body, as permanent parasites which do no appreciable injury, is very improbable. Many experiments which have been made lead to the conclusion that the animal organism in health is free from bacteria. This is an almost daily experience in the laboratory. Even the excretions, such as urine and milk, are free from bacterial life. Moreover, if there were harmless parasitic forms present, why should we always obtain the same microbe alone from organs affected with the same disease? That bacteria do occasionally penetrate into the closed cavities from the mucous surfaces need not be disputed, but they are quickly destroyed. Large numbers injected directly into the blood have been found greatly reduced in a few hours, and entirely absent after twenty-four hours. To impress this fact more firmly we may picture to ourselves our skin and the entire alimentary canal in contact with myriads of these organisms. A delicate mucous membrane is all that separates them from the vital organs. Yet not a single individual is capable of gaining a permanent foothold within this membrane. This applies only to non-parasitic species, however.

In contrast with this lasting enmity between bacteria and the healthy tissues is the more friendly relation between animal parasites and the latter. Trichinæ and tape-worm cysts enjoy an undisputed repose in the muscular tissue of their host. Some entozoa live in the connective tissue, others infest the blood; they have even been found within the blood-corpuscles of fishes and turtles of apparently normal vitality.

A survey of the various biological properties of those bacteria which have been more carefully studied up to the present does not reveal to us two extreme classes,—those that are capable of a parasitic existence only on the one hand, and those that can only live upon dead organic matter. We actually find bacteria possessing the vicarious power of living, now a parasitic, now a saprophytic existence. The microbes which occasion such diseases as anthrax, typhoid, glanders, cholera, etc., multiply readily in organic infusions in milk, even in drinking-water, for a variable period of time. They grow luxuriantly upon the cut surface of a boiled potato, which is a purely vegetable product. Bacteria of this kind are without doubt closely related to the numberless forms living in the soil and water, and drifted about, in a dried state, with currents of air. Yet they differ in some physiological function, some chemical power, which enables one group to destroy animal life, while the other is itself destroyed as soon as it enters the animal body. There are other parasitic bacteria which are much more fastidious in their choice of a subsistence outside of the body, which shun the boiled potato and require conditions approximating those found in the animal organism. The bacillus of tuberculosis flourishes only on blood-serum at the temperature of the body, and the gonococcus, according to Bumm, seems to prefer human blood to that of the lower animals.

Finally, there are parasitic forms only known to us from a microscopic examination of the tissues which they infest, such as the microbe of leprosy, and perhaps of syphilis. Cultivation upon nutrient substances has not yet succeeded. We must therefore infer that these forms have become so thoroughly adapted to a life in the tissues of the living body that the conditions there prevailing cannot be realized sufficiently in artificial culture to induce multiplication.

These facts explain why many pathogenic bacteria can be cultivated,—grown at will in tubes containing appropriate media; we simply make use of their capacity for living and multiplying upon dead matter, a capacity ancestral in its origin, and suggesting that all pathogenic bacteria were derived by a process of natural selection from the innumerable harmless species everywhere peopling the air, the soil, and the water. How the parasitic nature of these bodies was acquired gives ample scope for speculation, as nothing definite is known. To me it seems most reasonable to suppose that many of the bacteria now known to cause disease acquired certain physiological properties in their natural habitat, possibly in warm climates, which properties accidentally fitted them to live as parasites of the animal organism. These having once been brought together, a new disease, a new scourge was added to the inheritance of animal life. The parasite being subject to all the contingencies which affect other forms of life in nature, it may ingraft itself more and more upon the system, or it may die out in the course of time.

While assuming, without any infringement of known biological laws, that all parasitic bacteria were derived from saprophytic forms, the difference between them is so sharply defined as to make us stand in awe at the tremendous power of the one class when contrasted with the other. Millions of saprophytic bacteria may be introduced under the skin or into the blood-vessels of animals without any marked disturbance. A single pathogenic microbe, by rapid multiplication within the body, may destroy life in a day. The power thus acquired by these minutest and simplest of living organisms is one of fearful effect upon the most highly organized class of animals. It is a war of pigmies against giants, which ends with the destruction of either or both opponents. If the giant be only a rabbit, it is at least a billion times larger than each microbian opponent. If we take the larger animals or man, the relation in size between the microbe and its victim differs but little from that of the earth and the meteorite falling upon its surface.

The derivation of pathogenic from harmless saprophytes is well suggested by three organisms,—those causing Asiatic cholera and typhoid in man and so-called cholera among swine. These organisms thrive very well upon various media, indicating that they are not necessarily limited to the living body as a habitat. But the remarkable feature which they have in common is their power of spontaneous movement in liquids. During their parasitic life this function does not appear to be of any service whatever. The bacteria of cholera are restricted to the small intestine, where they multiply with enormous rapidity. Those of the other diseases mentioned are not limited to the intestines, but may be found growing in the blood-vessels of various organs in the form of dense colonies or plugs. The motility must be regarded as a feature of their saprophytic life which they would lose if a strictly parasitic habit were finally adopted. An illustration of a somewhat different nature is furnished by the *Anthrax bacillus*, the first disease-germ thoroughly studied, which produces such a rapidly fatal malady in many of the domesticated animals and in man. According to Koch, it is an inhabitant of certain low, marshy regions, where it goes through its cycle of growth without entering the animal body. In fact, it cannot complete this cycle within the body, for that most important stage—spore formation—only takes place on exposure to the air, so that bacilli within the dead body, if immediately buried, do not form spores. These facts illustrate clearly the preponderance of a saprophytic life in this very virulent organism.

To indicate graphically the probable phylogenesis of parasitic bacteria, Hüppe has constructed the following table, according to De Bary:

True Saprophytes.

- 1. Ferment bacteria.
  - Aerobiotic.
    - Agents of oxidization fermentations.
    - Facultative anaerobiotic.
      - Obligatory anaerobiotic.
- 2. Pigment bacteria.
- 3. Parasitic bacteria.
  - Facultative parasites.
    - Facultative saprophytes.
      - Obligatory parasites.

The term facultative parasites signifies that the bacteria included in the class are capable of living as parasites or of passing through certain stages of their development as parasites. Facultative saprophytes are such parasites which may live as saprophytes either during the whole or a part of their life-cycle.

If for a moment we look more carefully at the parasitic life of bacteria, a number of interesting facts and problems appear. First of all each microbe produces definitely characterized symptoms and lesions which are grouped together as a specific disease. According to the abode which the microbes choose in the animal body, these symptoms and lesions will vary within wide limits. Some species multiply within the capillary system of the various organs, some are confined to the lymphatics, while others produce suppuration in the connective tissue by attracting an army of leucocytes to oppose them. A few are constantly found within leucocytes themselves. Some bacterial diseases are limited to special organs or tissues. It may be the lungs or the spleen, the skin or the mucous membrane of the intestine which becomes the seat of attack, and to which the disease remains restricted. In the various situations minor modifications in disposition and grouping give rise to diseases of quite different character. Bacteria growing in dense plugs in the capillaries produce injuries and changes different from those which arise when they are loosely scattered.

It is a curious fact that those bacteria which are strictly parasitic and which have not yet been cultivated in nutritive media, or only with considerable difficulty, cause diseases which are very slow in their progress, often lasting for years and frequently checked and cured. Tuberculosis, syphilis, and leprosy are illustrations of this fact. On the other hand, the diseases which are produced by bacteria that thrive in artificial media are usually quite rapid in their course. The conflict in the latter case is much fiercer and more quickly decided. In other words, the bacteria are more virulent. The better adapted the parasite becomes, the more compatible will it be with the host and the less capable of carrying on an independent existence. It is for the interest of the more strictly parasitic forms that their host live as long as possible. This is not necessarily so with those species whose life in nature may continue more or less independent of a parasitic existence.

The more perfect parasitic bacteria, manifesting their presence in very slowly progressive maladies, usually reside within the protoplasm of the cells, where the feeble irritation leads to a hypertrophy and then to a gradual destruction of the cell itself. The bacteria are probably taken up in the same way in which the amœba takes in solid particles. The cell endeavors to destroy them in this way, but their persistence within the cell-protoplasm indicates that the struggle has resulted in the victory of the parasite, which even finds the battle-ground a convenient place of abode. There are one or two rapid diseases, such as mouse septicæmia, in which this intra-cellular habitat of the microbes is always observed.

Another interesting feature which they share with entozoa is their limitation to certain species of animals. Some are peculiar to one species, others may thrive upon several. This susceptibility of certain animals to definite pathogenic germs is so constant a phenomenon that it has now become an indispensable means in the diagnosis and differentiation of bacteria, and in conducting investigations upon obscure points in the life-history which are of direct practical value. In other words, the smaller animals are to the pathologist what chemical reagents are to the chemist.

I have already stated that there are many entozoa, inhabiting the tissues of their host, which do but little harm, and which may measure their parasitic existence by years, while a few, such as *Trichina spiralis*, are now and then fatal. Corresponding with these gradations in destructive effect there are similar gradations of virulence among bacteria. Some produce only local disturbances; they are speedily destroyed and eliminated. Among these are the microbes causing suppuration. Others destroy organs and tissues very gradually, and are indirectly fatal by exhausting the vital energies or breaking down some organ necessary functionally to the processes of life. Among these may be mentioned more particularly the tubercle bacillus. Still others may cause death from within a few hours to weeks after their invasion. These include the microbes of septicæmia, cholera, typhoid fever. In general, however, the tendency of bacterial parasites is eminently destructive. The chemical poisons formed during their growth irritate and finally destroy the animal cell. If we pass from a consideration of the biology of these micro-organisms to the diseases of which they are the cause, a broad field of interesting facts lies before us, as instructive and suggestive to the biologist and the student of nature as to the pathologist and the practical physician. I can, however, merely glean a few facts which may serve to illustrate the relation of epidemics to the life-history of bacteria.

There is a certain group of diseases called miasmatic, because the poison seems to come from the air and the soil. With the light shed upon this subject in recent years, the micro-organisms, presumably the cause, live in the soil as their natural habitat. This class would include all strictly endemic diseases, since they cannot be carried at will to localities free from them. The cause, residing in the soil, must have certain conditions necessary to its life, and unless these are found in new localities the disease will not take root. Though malaria is reaching out into new territory, we have never yet heard of a quarantine against its progress.

Another group includes maladies only transmitted from one subject to another. They are strictly contagious diseases, corresponding to the strictly parasitic bacteria, which cannot multiply outside of the animal body.

A third group, intermediate between these extremes, possesses, in a way, the characteristics of both. The micro-organisms may live both as parasites and saprophytes; and being capable of multiplying wherever the proper pabulum exists, the possibility of rapid diffusion, and hence of great epidemics, is readily conceivable. It is believed by some that for most of such germs a sojourn in the soil is a necessary preparation for the parasitic stage. Pettenkofer regards cholera and typhoid not contagious, but insists that the germs must first undergo some unknown changes in the soil before they again become capable of inducing disease. Hence the spread of epidemics depends as much upon certain external conditions as upon the presence of the agents themselves. This is controverted ground, however, and most authorities to-day are inclined to consider the air, the soil, and water as simple vehicles for the spread of disease.

There still remain many obscure problems concerning the movement of epidemics, but their solution does not seem so far away, as a very firm foundation has been laid for future observations. This has been constructed from the life-history of micro-organisms. The application of the principles and fundamental facts of biology to the elucidation of the causes of disease and its prevention is once more brilliantly vindicated. Disease is no longer the mysterious, personified entity of the past. It has been brought within the domain of laws which govern all life upon the earth.

ON SOME POPULAR ERRORS IN REGARD TO THE ESKIMOS.

BY JOHN MURDOCH.

ONE is often surprised, on taking up a popular treatise on anthropology, to find the number of erroneous beliefs concerning a race of people about whom so much has been written as about the Eskimos, which have been quoted by author after author without question, until they have come to be accepted by the world of readers as matters of established fact. Most of these errors are due to the fact that many of the earlier authors, even when themselves explorers who correctly recorded the facts they observed, hastily accepted the conclusion that isolated peculiarities were charăcteristic of the race as a whole, as if, for instance, the race of Englishmen should be described from the study of the inhabitants of a single county. Then the compilers, who had no means of ascertaining the correctness of the statements they had to work with, have perpetuated the beliefs. Even so acute an observer as Sir John Richardson has fallen into the error, in his "Polar Regions," of supposing that the peculiarities of manners and customs, correctly observed by him in certain limited areas, were universally practised throughout the whole extent of country inhabited by the Eskimos.

Certain authors of the present day, however, are not less to be blamed for this habit of hasty generalization.

In a manual of anthropology of the most recent date,[1] which might be supposed to contain the latest results of anthropological research, since one of the authors is a professor and the other an assistant professor in the "École d'Anthropologie" at Paris, in the midst of a concise characterization of the Eskimo race, remarkably correct, on the whole, for a compilation, is the statement, "polyandry is practised,"—"on pratique la polyandrie" (p. 537). The natural inference from this is that such a practice is general, or, at least, not uncommon, among the Eskimos.

Now, if one takes the pains to search through the original sources of information in regard to the Eskimos, as the writer has of late had the opportunity of doing to a great extent, it will be found that while sexual morality is everywhere, as a rule, at a low ebb among them, and polygamy is frequently mentioned, cases of polyandry, where a woman has two or more regular husbands, are very rarely referred to. In fact, the statement above quoted is probably based on the cases mentioned by Bancroft in his "Native Races of the Pacific States."

Bancroft states that in former times in the island of Kadiak, two husbands, a principal and a secondary one, or sort of *cicisbeo*, were allowed to one woman, but quotes no authority for this statement (vol. i. p. 82). Again, he refers to Seemann ("Voyage of the 'Herald,' vol. ii. p. 66), who says, speaking of the western Eskimos, "Two men sometimes marry the same woman." Seemann's acquaintance with the Eskimos, however, was only such as could be obtained in visits to Kotzebue Sound, in three successive summers, when the natives came on board the ship

[1] Précis d'Anthropologie, par Abel Hovelacque et Georges Hervé. Paris, 1887.

as she lay at anchor, and the people from the vessel occasionally visited the shore. I know from experience the difficulty of obtaining accurate information under such circumstances.

The statement, therefore, is not free from suspicion, especially as Seemann follows it up with another at variance with the experience of later explorers in the same region, and, indeed, of those who have been brought in contact with the Eskimos in most other places,—namely, that "after the marriage ceremony has been performed infidelity is very rare" (*ibid.*).

These instances stand almost alone. The only other case where anything of the kind is to be found is in Graah's "Narrative of an Expedition to the East Coast of Greenland," where he says, "report [among the West Greenlanders] said that the inhabitants of the East Coast were accustomed, when visited by scarcity, to destroy their women, so that the sex was usually at a premium among them, every woman having two or three husbands" (p. 78). He, however, makes no mention of finding any such cases among the East Greenlanders when he visited them, but, on the contrary, speaks of one man with two and another with three wives, which indicates anything but a scarcity of women.

On the same page of Hovelacque and Hervé's book it is stated, "Les Eskimaux habitent, selon la saison, des tentes de peaux ou des trous creusés en terre." "Holes dug in the earth" seems, to say the least, an exaggeration to one who has ever entered one of the comfortable and neatly-built wooden houses of the northwestern Eskimos, though these are covered by a mound of turf, or one of the extensive structures described by Captain Graah, who gives the most detailed description of the Greenlander's house ("Narrative," etc., pp. 45 and 46), sometimes sixty feet long, accommodating seven or eight families, with "regular walls, from six to eight feet high, built of earth and stones," roofed with beams covered with sticks and turf.

In fact, as far as I can discover from consulting a very large number of original authorities, the Eskimo winter-house is never more than partially underground, and in some cases even somewhat elevated above the surface of the earth, while throughout the great middle region, from Hudson's Bay northward among the archipelagos, the winter-house is generally of snow, built up, on the frozen ground. It is indeed surprising that anything so well known as these snow-houses should be passed by unmentioned by the authors of the "Précis d'Anthropologie."

In spite of all authorities, however, the belief appears to be very wide-spread that the Eskimo passes the long cold winter night—the darkness of which, by the way, is very much exaggerated in regard to most of the region inhabited by the Eskimos, considering that the extreme northern point of the American continent extends but little beyond latitude 71°—in a sort of hibernation in underground dens, living in enforced idleness and supporting life by stores of meat laid up in less inclement seasons.

As Bancroft puts it, "About the middle of October commences the long night of winter . . . and humanity huddles in subterranean dens; . . . in March the dozing Eskimo rubs his eyes and crawls forth" ("Native Races," i. pp. 43, 44); and again, "In midwinter, while the land is enveloped in darkness, the Eskimo dozes torpidly in his den" (p. 55).

But in reality the experience of all explorers shows that the Eskimo does nothing of the kind. If he did, he would soon perish from starvation, for improvidence is one of his greatest characteristics, and very little is done in the way of storing up supplies for the winter. To be sure, they do not live the same out-door life as in the continuous daylight of summer, but their winter-life is as far removed as possible from idleness or hibernation.

A sketch of the winter avocations of the Eskimos of Point Barrow, who came under my personal observation for two winters, will serve to illustrate the truth of this statement. Point Barrow lies in latitude 71° 16′ north, and consequently there are seventy-two days—from the middle of November to the latter part of January—when the sun does not appear above the horizon, though there is sufficient twilight from ten o'clock in the morning to three in the afternoon to enable one to work out-doors.

The sea is frozen over and the land covered with snow, but the seals have made their breathing-holes in the new ice, and are to be caught with the spear, while nets may be set surrounding cracks where they resort for air. Every fine day, and even some stormy ones, large numbers of men are scouring the ice in search of seals and bears, while others are busy at home with carpenter-work, often carried on in the open air, in spite of the cold.

The village by no means presents an appearance of torpidity. The children are playing out-doors, or going out with the dog-sleds along the beach for a load of fire-wood; parties are travelling back and forth between the adjacent villages, and even the old men who can no longer lounge round the assembly-house, because it is not heated, except on great occasions, are out in groups gossiping on the knolls, wrapped in their cloaks. At this season, too, visitors come from distant villages, and the great dances and semi-dramatic festivals are held.

With the "dark of the moon," late in December, comes the season for catching seals in the nets set along the rifts in the ice-field. Now the men stay out all night, night after night, in the coldest weather, and reap the great seal harvest of the year, a single man sometimes capturing as many as thirty in one night.

After the great seal-netting is over seals are still to be netted in small numbers, and hardly a day passes that the men who have stayed in the village are not out in greater or less numbers tending their nets, while all the women and children are busy catching little fish through holes in the ice. Meanwhile, the richer or more energetic families have started off with the first gleam of the returning sun for the hunting-grounds, three or four days inland, where they remain camped in snow-huts, hunting reindeer and catching white-fish through the ice of the rivers, till the approach of spring warns them to return for the whale-fishing. Thus the winter, in spite of the extreme inclemency of the climate, is passed in one continued round of activity.

Hovelacque and Hervé, however, are much more correct in regard to a point concerning which popular belief is most persistently at fault. If there is one article of popular faith regarding the Eskimos that passes unquestioned, it is that they are very small, if not actually dwarfish in stature. Our authors state that the pure-blooded Eskimos are of medium or small stature, according to the classification of Topinard, medium stature being 1.65 m. (about 5 feet 4 inches), and small stature, 1.60 m. (about 5 feet 1½ inches) and less. They believe that 1.62 m. (about 5 feet 3 inches) is the average for male Eskimos unmixed with Danish or Indian blood. (It is probable, however, that there exist few, if any, Eskimos whose blood is mixed with that of the Indians, since, till within a few years, Indians and Eskimos, where they came in contact, have been on terms of the deadliest hatred.)

Let us compare with this statement the measurements given by those who have actually observed the Eskimos.

All who have written about the western Eskimos agree that they are, if anything, above the middle height (see the authorities quoted by Bancroft). And this has been insisted upon as a point of difference between them and those of the east. This difference, however, does not hold good. Oldmixon's figures ("Report U. S. International Polar Expedition to Point Barrow," p. 50) show that the average height of males at Point Barrow (5 feet 3 inches) falls a little short of Topinard's "taille moyenne," while Parry gives 5 feet 5½ inches for the average of males at Igloolik ("Second Voyage," p. 492), and Schwatka states that the Eskimos of King William's Land are above the Caucasian race in stature, speaking of individuals 6 feet, or even 6 feet 6 inches, in height (*Science*, iv. p. 543). Parry, again, speaks of the men of Baffin Land, whom he met on his first voyage, as from 5 feet 4½ inches to 5 feet 6 inches in height; and another early explorer, Lieutenant Chappell, speaking of the natives of the north shore of Hudson's Strait, says, "The males are, generally speaking, between five feet five inches and five feet eight inches high" ("Voyage to Hudson's Bay, 1817," p. 59). According to Petitot ("Monographie des Esquimaux Tchigtit," p. xii.), "Les grands Esquimaux des bouches du Mackenzie et de l'Anderson sont d'une taille plutôt au-dessus qu'au-dessous de la moyenne. Il est parmi eux des hommes fort grands."

I can find but one series of measurements that at all corroborate the popular opinion of the small size of the Eskimos, and these are those taken by Dr. Sutherland at Cumberland Gulf. Here the average height of twenty-three adult males was found to be 5 feet 2.4 inches ("Journal Ethnological Society," iv. p. 213). Even this is above Topinard's standard of "petite taille."

Hovelacque and Hervé believe that the greater heights reported are due to admixtures of foreign blood, but it is worthy of notice that Schwatka's "giants" were found among a people who are far distant from any Indians, and have had little or no intercourse with the whites, and that most of the taller men at Point Barrow are of an age that precludes the possibility of their being the descendants of white men. Petitot expressly states (in the work referred to above), "On ne trouve chez eux [the Mackenzie Eskimos] de métis." On the other hand, the small race measured by Sutherland come from a region where they have been long in contact with the whites.

The evidence, therefore, seems strongly to contradict the popular belief. It is not unlikely that the popular idea arose from the fact that the earlier explorers compared the Eskimos with some of the tallest of the European race.

I am strongly inclined to believe that the very name by which we know these people owes its origin to a similar case of hasty generalization. "Eskimo," according to the best authorities, means "eater of raw flesh," and most people believe that all Eskimos habitually eat their food raw, devouring enormous quantities of reeking flesh and blubber.

Undoubtedly flesh is sometimes eaten raw, especially in a frozen state, and in certain limited regions where fuel is very scarce, raw-flesh eating appears from necessity to have become a habit, as, for instance, at Cumberland Gulf (*teste* Kumlien, "Bulletin U. S. National Museum," No. 15, p. 20).

Nevertheless, most observations indicate that this habit is exceptional, and the writings of all the original observers, from the time of Egede and Crantz, are full of accounts of the cooking of food, even when the oil-lamps furnished the only fire for this purpose.

Captain Parry explicitly states that the people of Igloolik preferred to boil their food when they could obtain fuel ("Second Voyage," p. 505), and we, also, found that food was habitually cooked at Point Barrow, though certain articles, like the "black skin" of the whale, were usually eaten raw.

The enormous consumption of fat, supposed to be a physiological necessity to enable them to withstand the excessive cold, is probably the exception rather than the rule, to judge from the accounts of actual observers. It seems quite probable that the amount consumed in most cases is little, if any, greater than that eaten by civilized nations, when we consider that the people who eat the fat of the seal with the flesh and use oil for a sauce to their dried salmon, have no butter, cream, fat bacon, olive oil, or lard.

We found, indeed, at Point Barrow, that comparatively little actual blubber either of the seal or whale was eaten, though the fat of birds and the reindeer was freely partaken of. Seal or whale blubber was too valuable,—for burning in the lamps, oiling leather, and many other purposes, especially for trade.

Neither does the general belief that they drink train-oil appear to be supported by reliable evidence, and some authors in various localities especially deny it.

I trust that I have presented sufficient evidence to show that the popular picture of the dwarfish Eskimo, dozing in an underground den, keeping up his internal heat by enormous meals of raw blubber washed down with draughts of lamp-oil, is based on exaggeration, to say the least, rather than on actual facts.

THE SIGNIFICANCE OF SEX.

BY JULIUS NELSON.

EXPLANATION OF PLATES I—IV.

The figures have been selected to show as great a variety as possible, that the unity which can be discovered may be a generalization of value. For the sake of clearness they have been drawn with as little elaborateness as possible, and to that extent are diagrammatic.

The following abbreviations have been used:

Z. w. Z.—Zeitschrift für wissenschaftliche Zoologie.

M. J.—Morphologisches Jahrbuch.

Carnoy.—La Biologie Cellulaire, 1884.

Bütschli.—"Protozoa," in Bronn's Classen und Ordnungen des Thierreichs.

A. B.—Archives de Biologie—Beneden and Bambeke.

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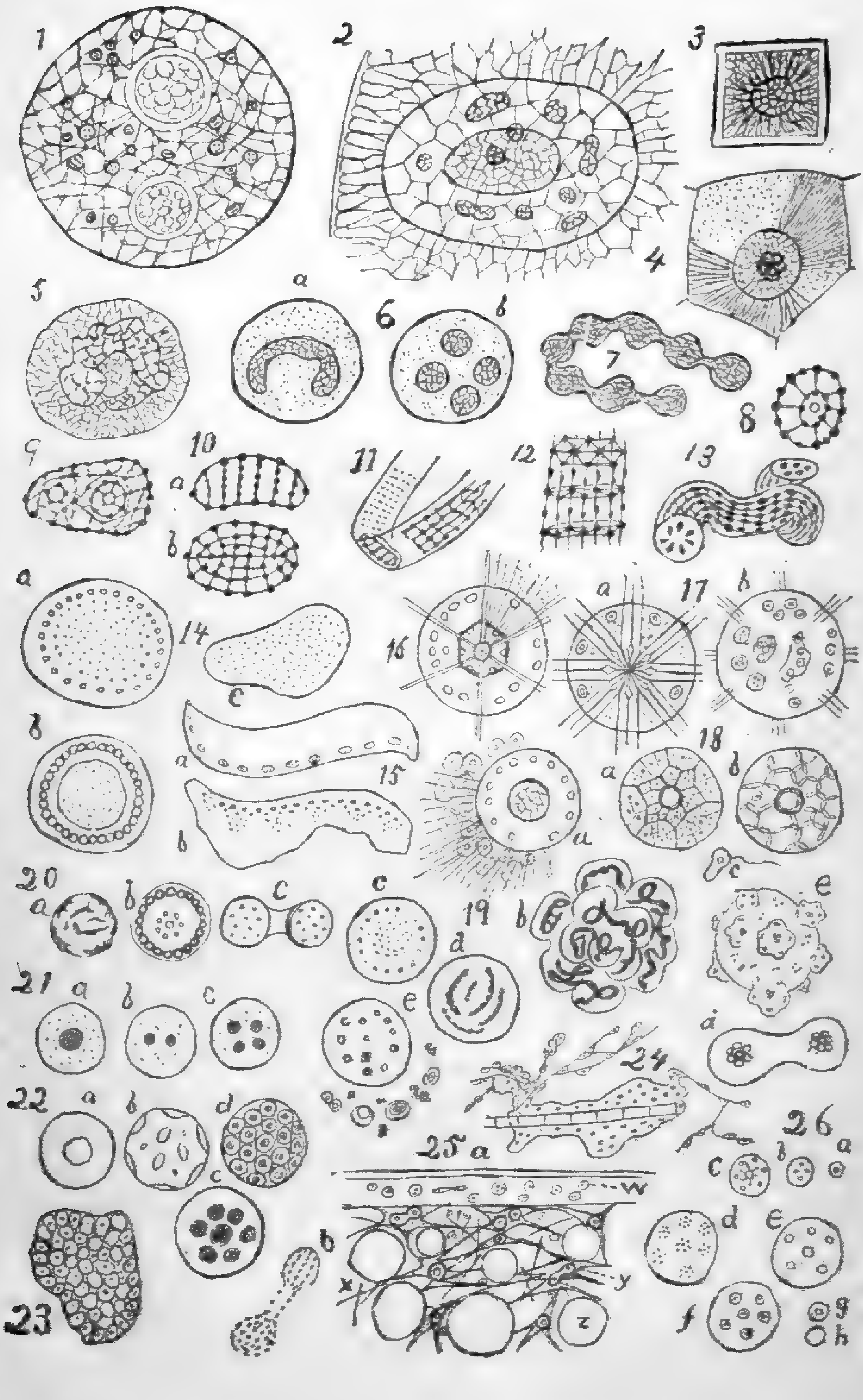
PLATE I.

FIG. 1. *Actinosphærium eichornii*—Gruber,[1] Z. w. Z., xxxviii.—The protoplasm is in the form of a net-work with enlarged nodes, many of which bear nuclei in various stages of karyokinesis.

FIG. 2. *Calcarina spengleri*—Bütschli, M. J., xi.—A nucleus surrounded by reticulated protoplasm is shown. It contains one large and several small nucleoli, all

[1] The name following the species refers to the author of the paper from which the figure was copied, and does not necessarily refer to the discoverer of the species.

PLATE I.



having essentially the same reticulate structure. Some of the nucleoli are dividing by simple constriction.

FIG. 3. *Intestinal epithelium cell* of an *insect*—Carnoy, p. 190.—The reticulate nucleus is slung by a fine net-work, whose radial trabeculæ are the more pronounced; they branch towards the periphery of the cell.

FIG. 4. *Intestinal epithelium* from an insect larva—Carnoy, p. 195.—The granules in the cytoplasm have been indicated in some sectors, and the reticulum in others. The heavy nuclear reticulum, containing the chromatin, has contracted under the action of the *chrom-aceto-osmic* mixture of Flemming, and reveals a fine reticulum of achromatic protoplasm otherwise obscured by the presence of the chromatic reticulum (or filament, as the case may be).

FIG. 5. *Giant-cell* from marrow of rabbit—Carnoy, p. 262.

FIG. 6. *Encysted Vorticella*—Carnoy, p. 261.—In *b* the nucleus has divided into four.

FIG. 7. Nucleus of *Stentor polymorphus*—Carnoy, p. 260.

FIG. 8. Nucleus of *Monas vivipara*—Bütschli.—Microsomata of various sizes are united by processes so as to form a regular net-work.

FIG. 9. Nucleus of *Ceratium tripos*—Bütschli.—One of the nucleoli has an internal reticulum; the other is vesicular, having only a *surface* reticulum.

FIG. 10. Nucleus of *Ceratium tripos*—Bütschli.—No nucleoli present. *a* is an optic section from the side, *b* is a view of the ventral surface. The microsomata are strung in a row on each of the dorso-ventral filaments.

FIG. 11. Tentacle of *Noctiluca miliaris*—Bütschli.

FIG. 12. Diagram illustrating the structure of striped muscle—Melland, Q. J. M. S., xxv.

See also 93, *d*—Van Beneden, A. B., iv.—Contraction and amœboid movement accompanied, perhaps caused, by mutual attraction of the microsomata.

FIG. 13. Nuclein filament from a gland-cell of an insect—Carnoy, p. 233.—The chromatic microsomata are arranged in a reticulum imbedded in the surface of the *hyaloplasm filament* (nucleolus).

FIG. 14, *a*. A nucleus of *Amœba proteus*—Gruber, Z. w. Z., xli.—The chromatin granules are largest peripherally. In *b* (Z. w. Z., xl.) there is a differentiation of a large central nucleolus with fine granules from a surface membrane of large, closely united microsomata. At times the microsomata are reduced to so fine granules that only a diffuse staining results.

FIG. 14, *c*. *Chænia teres*—Gruber, Z. w. Z., xl.—The chromatin granules have grown from invisible points.

FIG. 15. *Trachelocerca phœnicopterus*—Gruber, Z. w. Z., xl.—Like Fig. 14, this cell (rhizopod) is multinucleate. In *a* nucleoli appear in each nucleus; in *b* the nuclei have broken down to the state of free microsomata that divide up finer and finer.

FIG. 16. *Haliomma erinaceus*—Bütschli, after Hertwig.—The central capsule only is shown, with its large central nucleus and peripheral smaller nuclei budded from the central one, which has itself peripheral "nucleoli" that resemble the small "nuclei."

FIG. 17. Central capsule of *Acanthometra*. *a*, Bütschli, after Hertwig; *b*, after Stein.—In *b* the nucleoli have become independent bodies, and are separated by irregular division of the nucleus into individual nuclei, probably for reproductive purposes.

FIG. 18. Central capsule of *Collozoum inerme*—Bütschli, after Hertwig, etc. In *a*

the nucleoli are getting clothed with a definitely bounded plasma. In *b* these new cells or germs have become elongate and arranged in a reticulum like that of Hydrodictyon; later they become free and are expelled as flagellate monads, as at *c*. *d* is a young capsule dividing; the nucleus consists of a group of nucleoli or microsomata. *e* is an older capsule budding.

FIG. 19, *a–b*. Central capsule of *Thalassicolla pelagica*—Bütschli, after Haeckel. *b* shows the nucleus budding; it now has its chromatin in a filament which here and there preserves its reticulate arrangement seen in *a*.

FIG. 19, *c–e*. Capsule of *Th. nucleata*—Bütschli, from Hertwig, etc.—In *c* the chromatin is in a surface layer of microsomata and a central granular mass. In *d* the microsomata are in the form of beaded filaments. In *e* the capsule contains many small nuclei dividing, and outside are similar groups that have probably migrated from the capsule.

FIG. 20, *a*. Nucleus from *Amœba lucida* (multinucleate)—Gruber, Z.. w. Z. xli.—The "membrane" bounding the nucleoplasm is at a distance outside of that in which the chromatin bodies lie. These have irregular processes in *a*, indicating the presence of a reticulum. In *e* the nucleus is dividing; the two daughters are still connected by a bridge of hyaloplasm like that which is seen in Figs. 41, 42, etc.

FIG. 21, *a–c*. Nucleus of *A. prima*—Gruber, Z. w. Z., xli.

FIG. 22, *a–d*. Nucleus of *Euglypha alveolata*—Gruber, Z. w. Z., xl.—*a* shows a central nucleolus, *b* many peripheral ones. In *c* they are massed near the centre; in *d* they have multiplied so as to fill the nucleus, and each has taken on itself a structure similar to *a*. This reminds us of the "germinal balls" of Stein and others.

FIG. 23. Nucleus of *Ceratium tripos*—Stein, filled with germs that are set free to reproduce the mother.

FIG. 24. *Labyrinthula*—Cieukowski, A. m. A., iii. (see Lankester, "Protozoa," Encyc. Brit.).—The plasma in which the simple nucleolus-like bodies live, move, and divide is in the act of digesting a conferva filament.

FIG. 25. A section near the surface of *Sphærozoum neapolitana*—Bütschli, after Haeckel.—A layer of "yellow cells" (symbiotic) lies on the surface. The body is formed of spherical vacuoles, "needles," and a "syncytium" of nucleated plasma masses, united by processes with one another. Compare Fig. 1, also volvox, a reticulum of nerve-cells, and Figs. 8–10, etc. The physiological reason for this structure is probably alike in these various cases. *b* shows a nucleus dividing, the nodes of its reticulum appear as granules. Homogeneous nuclei dividing are often amœboid.

FIG. 26, *a–h*. A nucleus of *Pelomyxa villosa*—Greeff, A. m. A., x.—*a* has one nucleolus. In *c* there are several, one central, and a peripheral set. In *d* each has split up into a group of granules or small microsomata; in *e* these have again united, and in each nucleolus repeats the structure of *a*, and is set free as *g*. *h* is a "refringent corpuscle," formed from *g* by disappearance of the nucleolus.

PLATE II.

FIG. 27, *a–e*. Nucleus of *Klossia octopiana*—Schneider, A. Z. E. G., 2d ser., i.—*a* shows a complex nucleolus budding off smaller nucleoli, which in *c* ultimately become nucleolated; *d* shows nuclei dividing; *e* shows a cyst where the remains of the old nucleus is surrounded by the "spores" that were budded off.

FIG. 28, *a–c*. *Stylorhynchus oblongatus*—Bütschli, after Schneider, A. Z. E. G., iv. —In *a*, a spore-cyst is burst and the spores come out in strings, reminding us of beaded filaments in karyokinesis, also of Figs. 7, 10, *a*, 19, *d*, 31, 41, etc. *b* shows a nucleus budding off spores, and *c* is a spore set free.

PLATE II.

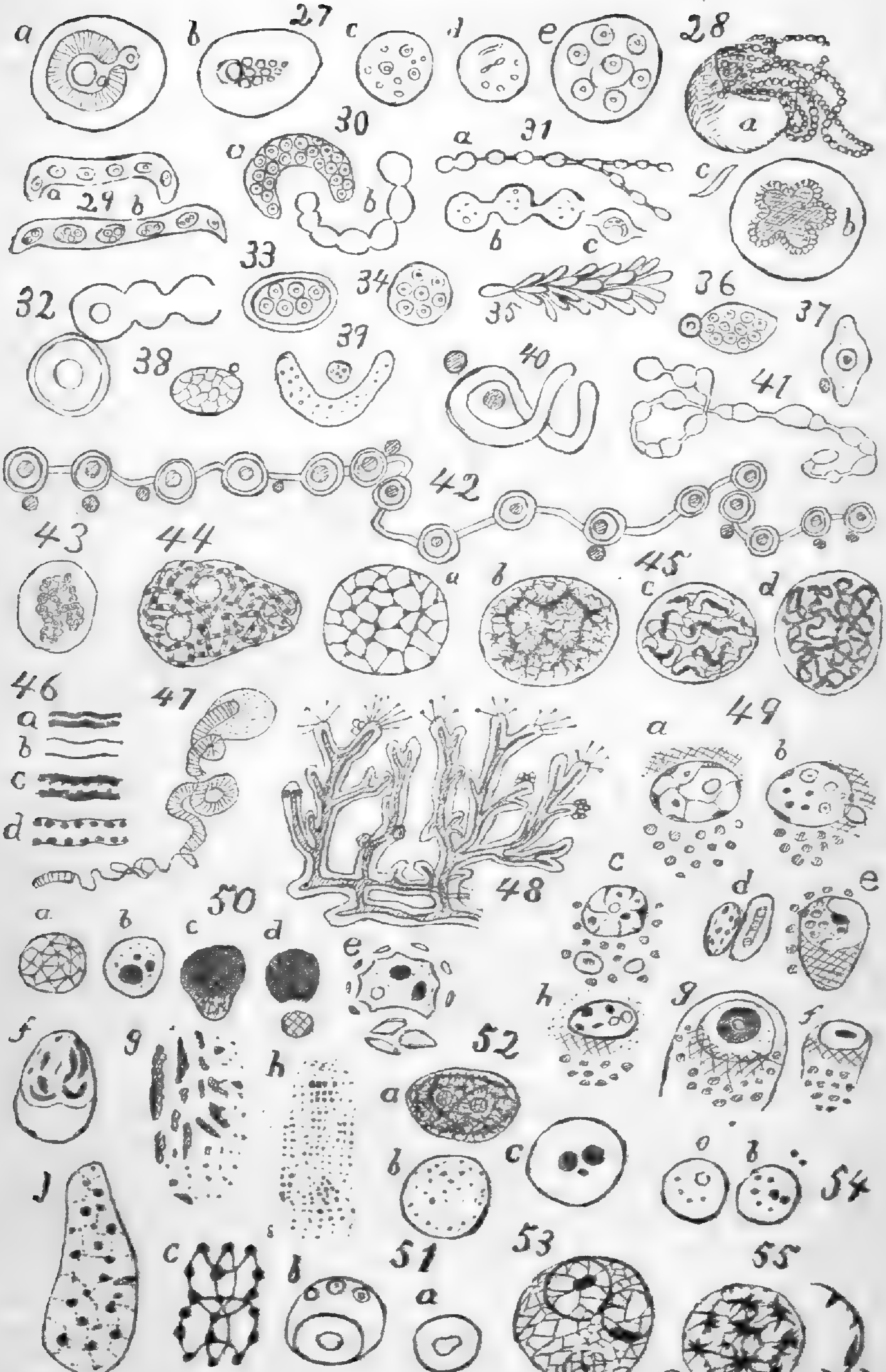

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FIG. 29, *a–b*. Nucleus of *Carchesium polypinum*—Greeff (see Kent, Plate 50).—The hyaloplasm does not appear constricted between the microsomata as in Fig. 31, etc. Each microsoma behaves like a nucleus and gets nucleoli, which themselves become cells like the germs of the "germ-balls." Sexual conjugation is reported as having preceded this state.

FIG. 30. *a–b*, Nucleus of *Actinobolus radians*—Entz, M. z. S. N., vol. v.—*a*, "germ-ball" state; *b*, stentor state.

FIG. 31, *a–c*. *Stentor polymorphus* (nucleus)—Stein (Kent, Plate 50).—The fork in *a* caused by branched budding of one of the microsomata. In *b* and *c* the chromatin has contracted to form itself into the reproductive state of germs.

FIG. 32. Portion of nucleus of *S. ræselii*—Claparède and Lachmann (Kent).—The nucleolus of the part segmented off becomes the nucleus of a new growth.

FIG. 33. Nucleus of *Urostyla grandis*—Bütschli (Kent).—"Germ-ball" state.

FIG. 34. Nucleus of *Acineta jolii*—Maupas, A. Z. E. G., ser. 1, vol. ix. (Kent).

FIG. 35. Nucleus of *Plagiotoma lumbrici*—Stein (Kent).

FIG. 36. Nucleus of *Oxytricha*—Gruber, Z. w. Z., xli.

FIG. 37. Nucleus of *Chilodon cucullus*—Wrzesniowski, A. m. A. V., vol. v. (Kent).—The nucleolus in nucleated and a "paranucleus" resembling this subnucleolus rests against the nucleus.

FIG. 38. Nucleus of *Acineta fœtida*—Maupas, A. Z. E. G., ser. 1, ix. (Kent).

FIG. 39. Nucleus of *Vorticella*—Gruber, Z. w. Z., xli.—Notice a paranucleus on the concave side of the "horse-shoe" nucleus.

FIG. 40. Nucleus of *Leucophyrs patula*—Kent, Plate 29.

Here are seen two paranuclei.

FIG. 41. Nucleus of *Loxophyllum meleagris*—Bütschli (Kent). Microsomata in act of dividing and so forming the beaded filament.

FIG. 42. Nucleus of *Loxodes rostrum*—Wrzesniowski, Z. w. Z., xx. (Kent).—Paranuclei accompany some of the sub-nuclei.

FIG. 43. Cell from *pedal ganglion of Arion*—Carnoy, p. 212.—The nucleus is in the form of a beaded filament in an "open" knot or tangle ("Knäuel").

FIG. 44. Nucleus of *epidermis* cell of an *Orchid*—Carnoy, p. 215.—The nucleus contains two reticulated nucleoli and a chromatic filament in a "close" tangle. The chromatin is in disks, and the intervening hyaloplasm is not constricted, hence the filament is not beaded.

FIG. 45. Nucleus of *epidermis* cell of *Salamander*—Carnoy, p. 219.—In *a*, a coarse reticulum is formed by fusion of the chromatic filament at various nodes of a close tangle. In *b* the connections have been broken, and a continuous filament once more formed, which, by shortening, becomes an "open" tangle, and the phases of karyokinesis follow. The chromatin is diffused throughout the filament. In *c* we see the chromatin withdrawing from the processes of the meshes and gathering in a definite path to form the beaded filament seen constructed into segments in *d*.

FIG. 46. Longitudinal optic sections of various *chromatic filaments*—Carnoy, p. 232.—To show the disposition of the chromatin. In all the chromatin is superficial, forming a thick wall in *a*, thin in *b*, thick with interior processes in *c*, and in *d* all gathered in annular segments distinct from one another.

FIG. 47. A filament dragged out of the nucleus by the section-knife, Carnoy, p. 234, shows that the chromatin is sometimes arranged in a spiral on the wall of the hyaloplastic filament, and may be pulled out like the threads from spiral ducts of plants.

FIG. 48. Fragment of a branching *Acinetan*—Bolton (Kent, Plate 47).—The nu-

cleus runs like an axis through all the stems and branches, and is segmented off into all the buds and spores.

FIG. 49, *a–h*. ***Amphibian pancreas cell***—Ogata, A. A. P. (Phys. Abth.) 1883.—The tissue hardened in warm corrosive sublimate is cut into thin sections and stained successively with ***hæmatoxylin***, ***nigrosin***, ***eosin***, and ***safranin***. Gaule, the author of this method, claims that there are two substances in the ***cytoplasm***, one ***eosinophilous***, the other ***nigrosinophilous***. There are also two substances in the ***nucleoplasm***, one staining best with ***hæmatoxylin*** (ordinary ***chromatin***), and the other best with ***safranin***. The ***chromatin*** is represented dead-black or heavily reticulated, the ***safraninophil*** is outlined only; the ***eosinophil*** is marked with parallel lines, the ***nigrosinophil*** by crossed lines and dots.

A. The nucleus lies imbedded in cytohyaloplasm (nigrosinophil) well marked on one side. On the other are the *zymogen granules* (eosinophil). A sparse reticulum, several small and mostly peripheral nucleoli (chromatin), and one large nucleolus, the "plasmosoma" (safraninophil), occupy the nucleus. In *b* the plasmosoma is migrating from the nucleus which now atrophies. In *c* the plasmosoma, now in the cytoplasm, begins to develop the two constituents of cytoplasm in its interior. It grows rapidly (*d*) to the size of the old nucleus, alongside which it lies. In *e* it has become still larger, and most of it has become transformed into zymogen granules and cytoplasm. In the centre of the remainder, *f*, a chromatin nucleus appears, which, later, differentiates in its interior, the plasmosoma and other nucleoli, *g*, *h*; and so we are back to stage *a* again.

FIG. 50. Nucleus of egg of *Colymbetes fuscus* (Will, Z. w. Z., xliii.), during ovigenesis and yelk formation.—*a*, reticulated; *b*, nucleolated; *c*, the chromatin growing and enlarging one or more of the nucleoli until all is homogeneous in *d*. It then buds off large and small cells; the former become reticulated and atrophy, the latter become follicle-cells. Then sheet after sheet of the nucleus dissolves off and is transformed to yelk-granules (*e*, *f*, *g*), the chromatin breaks down into granules, and microsomata of a beaded filament in a reticulum enclosing several nucleoli (*h*, *j*), and finally the karyokinetic spindle of the polar globule is formed.

FIG. 51. Nucleus of egg of ***Ascaris megalocephala***—*b*, *c*, Van Beneden, A. B., iv.; *a*, Nussbaum, A. m. A., xxiii.—The multiplication of a single nucleolus produces one large nucleolated nucleolus (the "prothyalosome") and several smaller ones; *b*, the prothyalosome alone takes part in forming the polar globules, and its residue copulates with the male pronucleus; *c* is the nucleolus of the prothyalsome highly magnified, seen to consist in this stage of two disks, each of four-beaded filaments (the beads being the chromatic microsomata). Compare Carnoy, see Fig. 124.

FIG. 52, *a–c*. Nucleus of egg of ***Pike***—Carnoy, p. 233.—In *a* we have a reticulum and nucleoli. In *b* the reticulum is broken up into nucleoli. In *c* these have fused to three.

FIG. 53. Nucleus of egg of ***Nephthys scolopendroides***—Carnoy, p. 237.

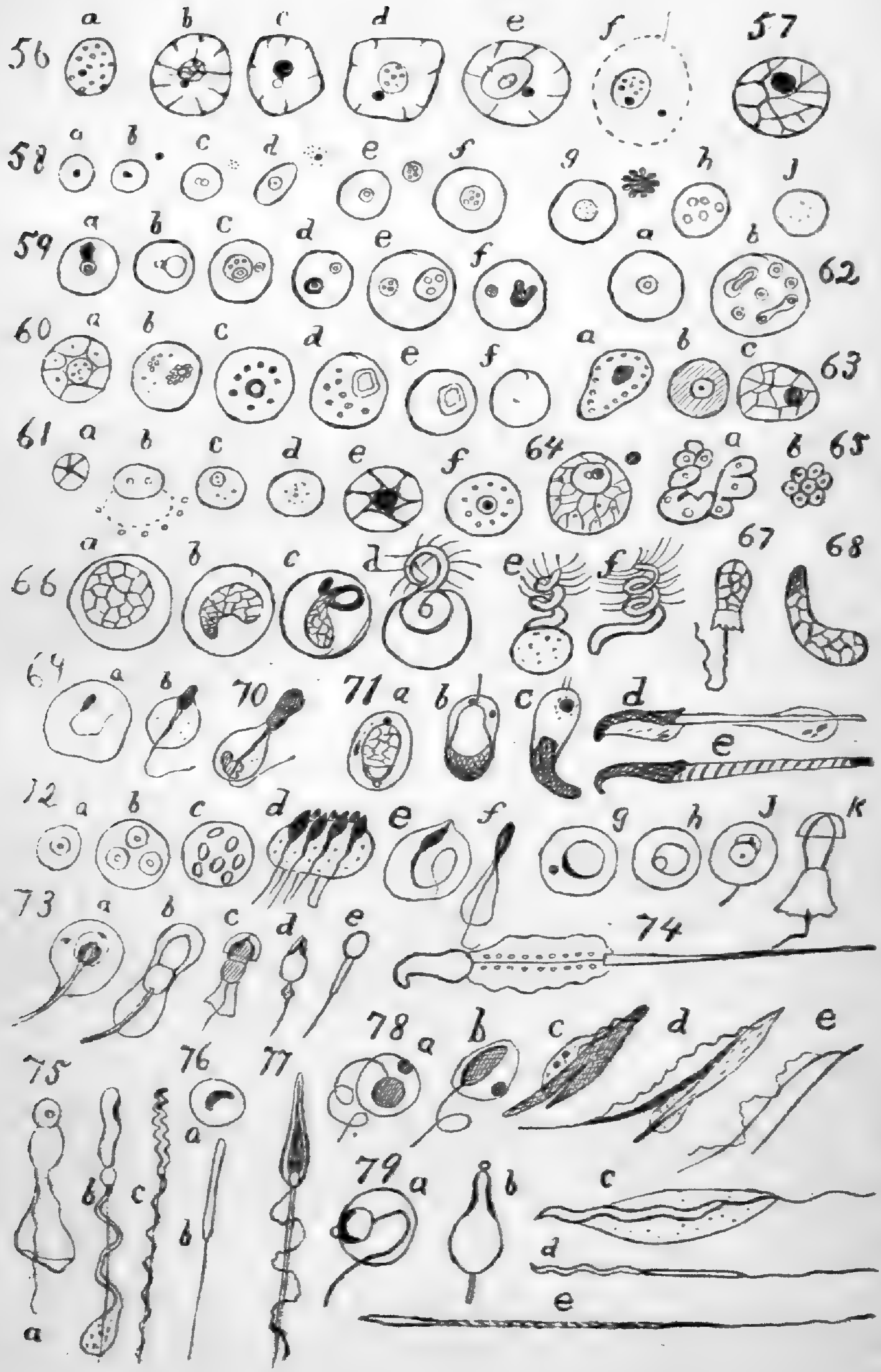
FIG. 54, *a–b*. Nucleus of egg of ***Field-Mouse***—Rauber. M. J., viii.

FIG. 55, *a–b*. Nucleus of egg of ***Perch***—Rauber. M. J., viii.—In *a* the microsomata are superficial and their processes suggest a reticulum; *b* is an optic section.

PLATE III.

FIG. 56, *a–f*. Nucleus of egg of ***Arion*** during ovigenesis and yelk formation, Platner, A. m. A., xxvi.—In *a* we see a nucleolus and microsomata and a paranucleus. In *b* the membrane of the nucleus shows the presence of a sparse reticulum, but the microsomata have concentrated to form a reticulated nucleolus, while the old nucle-

PLATE III.



olus is left outside as a paranucleolus. In *c* the nucleolus is homogeneous. In *d* it has microsomata, which fuse to one "nucleolus-nucleus" in *e*. Finally, in *f* the nucleolus has all the structure of the old nucleus of stage *a*. The membrane of the old nucleus now dissolves in the yelk, leaving the paranucleus as a "yelk nucleus."

FIG. 57. Nucleus of egg of *Toxopneustes*—Flemming.

FIG. 58, *a–j*. Nucleus of egg of *Spider*—Carus, Z. w. Z., ii.—In *b* a paranucleus appears, whose changes are as complex as those of the nucleolus. Finally, in *j* we have only a vesicle left.

FIG. 59, *a–f*. Nucleus of egg of larva of *Libelula*—Valette St. George, A. m. A., ii.—The structure of the large nucleolus in *c* reminds us of the entire nucleus of Fig. 51, *b*.

FIG. 60, *a–f*. Nucleus of egg of *Asteracanthion*—Van Beneden, Q. J. M. S., xvi. —The vesicle-stage of *f* is reported finally to disappear.

FIG. 61, *a–f*. Nucleus of egg of *Rabbit*.

FIG. 62, *a–b*. Nucleus of *Gonothyraca loveni*—Bergh, M. J., v.—Multiplication of nucleoli by division.

FIG. 63, *a–c*. Nucleus of egg of *Bat*—Beneden and Julin, A. B., i.

FIG. 64. Nucleus of egg of *Anodon*—Flemming, A. m. A., x.—A paranucleus is seen also.

FIG. 65, *a–b*. Nuclei of sexual cells ("primitive ova") of *Rana*—Nussbaum, A. m. A., xviii.—*a* of male, *b* of female. Budding of the nucleus in ovigenesis and spermatogenesis at this stage is often reported.

FIGS. 66–93 illustrate the formation of the spermatozoon from the nucleus of the "spermatid," and points in its structure.

FIG. 66. Antherozoids of *Hymenophyllum*—Carnoy, p. 226.—*a* shows the large reticulate nucleus of the daughter-cell of an antheridium. In *b* the nuclei is elongating, curved, and at its smaller end the net-work of chromatin is changing to the diffuse state. In *d* the pointed end protrudes from the cell and bears the locomotive cilia. This is homologous with the head end of a spermatozoon. The cytoplasm is gradually utilized as pabulum by the antherozoid, the residue remaining stuck to its hinder end *e* (which is finished last), to be finally fully absorbed or thrown off as at *f*.

FIG. 67. Spermatozoid of *Anodonta cellensis*—Carnoy, p. 225.

FIG. 68. Early stage of spermatozoid of *Salamander*—Flemming.*

FIG. 69, *a–b*. *Human spermatozoa*, not yet freed from their matrix—Wiedersperg, A. m. A., xxv.

FIG. 70. Spermatozoid of *Elephant*—Weidersperg, A. m. A., xxv.—The head and tail project from the cell, the "neck" or "middle" piece is still growing. In the cytoplasm are the remains of the paranucleus.

FIG. 71, *a–e*. Spermatogenesis of *Rat*—Brown, Q. J. M. S., July, 1885.—*a*, nucleus of spermatid beginning its transformation. At one end the chromatin becomes diffuse, and here also is a ***head-corpuscle***. At the opposite end is a ***tail-corpuscle***. In the cytoplasm lies a paranucleus. *b* shows the fine ***axis of the neck and tail*** proceeding from near the ***tail-corpuscle***. In *c* the whole nucleus has become homogeneous, elongated and curved, and mostly protruded from the cytoplasm. *d* shows the sperm. nearly completed; a relic of cytoplasm remains sticking where the head and neck join, and another where the tail and neck join. The latter contains the remains of the paranucleus ("seminal granules"). *e* is the completed sperm. The neck shows a spiral structure.

FIG. 72, *a–f*. Sperm. of *Bull*—Kölliker, Z. w. Z., vii.; *g–k*, Brunn, A. m. A.,

xii. and xxiii.—The multiplication of the nucleus of the spermatogonium when the division of the cytoplasm is partially or wholly suppressed, causes several spermatids (and hence spermatozoa) to be united to or in a single cell, and so forming spermatogemmes. *a-d* illustrate this point, which with mammals is not the rule. The concentration of chromatin in one side of the nucleus near a head-corpuscle, the formation of a cap in connection with this corpuscle, is illustrated in *g–k*. The other granule is either the paranucleus or tail-corpuscle. In *k* the membrane covering the middle and hinder part of the head is lost or not separated away like the cap. The "collar" about the neck is the membrane of the old cell.

FIG. 73, *a–f*. Sperm. of *Rabbit*—Brunn, A. m. A., xii.—*a*, after Platner, A. m. A., xxv., shows the paranucleus, the cap and head-corpuscle, the chromatic head enveloping the forward end of the neck-piece or its axis. *b* shows the nucleus in two parts, the posterior portion grows smaller, the chromatin is concentrated in the anterior part of the anterior portion, which forms the head. *e* is from Schweigger-Seidel, A. m. A., i., to show the finished spermatozoon.

FIG. 74. Sperm. of *Mouse*—Brunn, A. m. A., xxiii.—Corpuscles arrange themselves about the axis of the middle piece and build it up, so that in the finished specimen the neck is annulated.

FIG. 75, *a–c*. Sperm. of *Sparrow*—Brunn, A. m. A., xxiii.—Here the cytoplasm spins a filament that winds spirally about the axis, but remains separate from it.

FIG. 76, *a*, *b*. Sperm. of *Pigeon*—Kölliker, Z. w. Z., vii.

FIG. 77. Sperm. of *Triton*—Schweigger-Seidel, A. m. A., i.—The sinuous filament represents the thickened edge of a delicate membrane, which slings it to the tail like a mesentery. See Gibbes, Q. J. M. S., xix., for same structure in salamander, and Fig. 78, *c–e*, for the frog.

FIG. 78, *a–e*. Sperm. of *Bombinator*—Valette St. George, A. m. A., xxv.—*e* is the skeleton left after macerating away the sarcode.

FIG. 79, *a–e*. Sperm. of *Raja clavata*—Jensen, A. B., iv.

PLATE IV.

FIG. 80, *a–e*. Sperm. of *Branchiobdella*—Voigt, A. z. z. I. W., vii.—In *a* we have a large nucleus, to which is fastened a *tail-corpuscle;* we have also a small paranucleus, but this grows, fastens itself to the nucleus at the end opposite the *tail-corpuscle*, and proceeds to spin a spirallated piece like the middle piece of Figs. 71, 79, etc., but it here has the place of a head-cap, though its functions are probably unchanged.

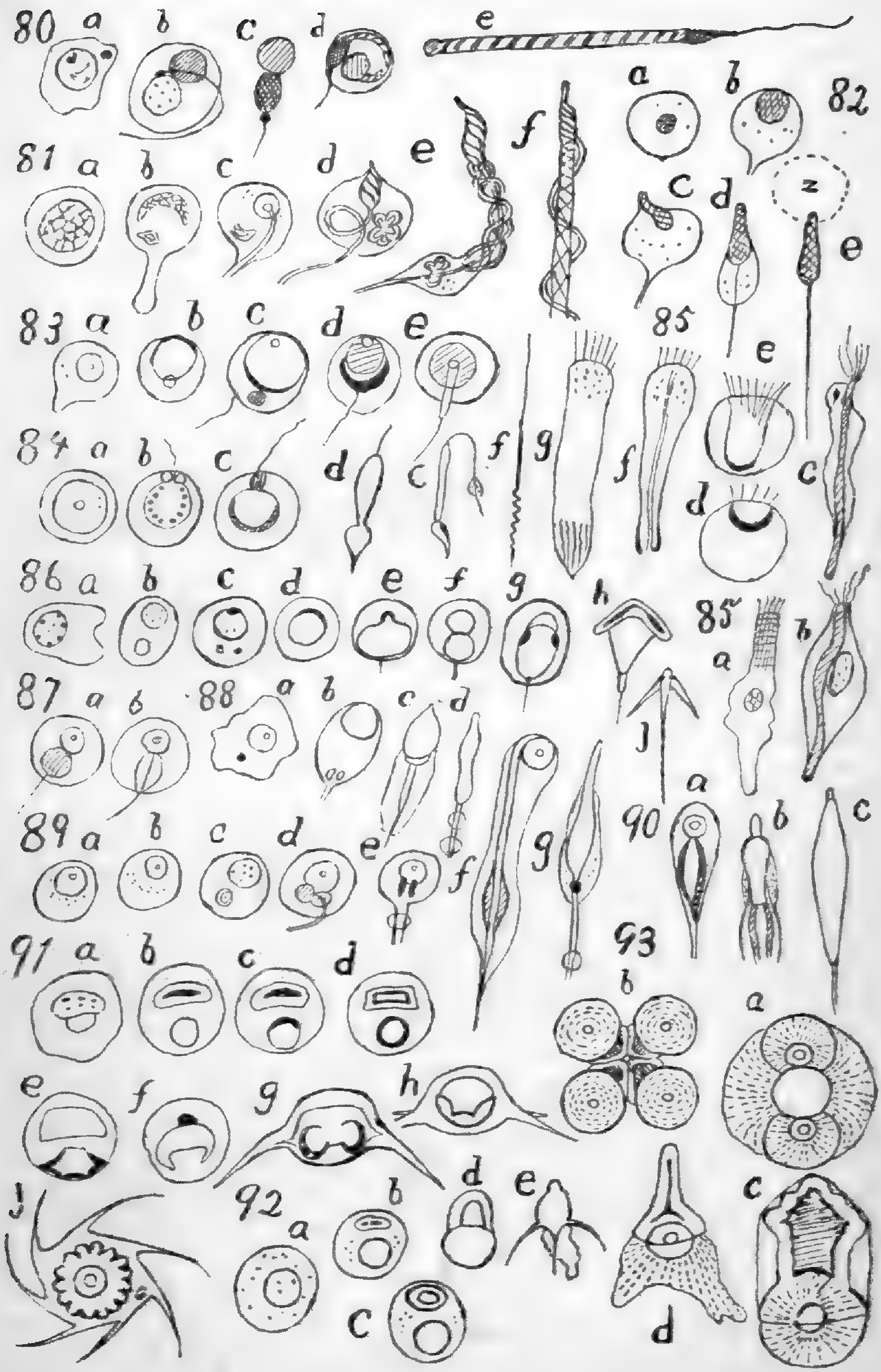
FIG. 81, *a–f*. Sperm. of *Helix*—Platner, A. m. A., xxv.—Here the nucleus buds off a paranucleus, then concentrates, becomes homogeneous, an axis appears, over its end the nucleus invaginates itself, while the cytoplasm containing the paranucleus spins three spiral filaments; two of these closely invest the axis, the third remains free.

FIG. 82, *a–c*. Sperm. of *Cassiopeia*—Mereschkowski, A. Z. E. G., x.—In *c* the dotted line is a portion of the circumference of the "blastophore," the protoplasmic "cell" which bears the spermatozooids imbedded by their heads over its surface.

FIG. 83, *a–e*. Sperm. of *Cucumaria frondosa*—Jensen, A. B., iv.—Head- and tail-corpuscles are seen. In *e* a middle piece in connection with the tail-corpuscle is seen. The spermatozoon is still unfinished.

FIG. 84, *a–g*. Spermatazoon of *Paludina vivipara*—"hair form" (functional), Brunn, A. m. A., xxiii.—In *b* are seen two tail-corpuscles and peripheral microsomata of chromatin that diffuse in *c*. *f* is the finished sperm., *g* is a bundle of them.

PLATE IV.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91 a b c d e f g h
93 b a c d
92 a b c d e

FIG. 85, *a–f.* Sperm. of *Paludina vivipara*—vermiform (not functional), *a–c*, Carnoy, p. 228.—The nucleus here plays no direct part in the formation, but acts like a paranucleus. *d–f*, Brunn, A. m. A., xxiii. The nucleus is here represented as directly concerned. Compare *f* and 84, *g*.

FIG. 86, *a–j.* Sperm. of *Locusta viridissimi*—*a*, *b*, and *h*, Valette St. George, A. m. A., x.; *c–j*, Brunn, A. m. A., xxiii.—Here, as in Fig. 73, the head (*f*) divides into two parts, the anterior of which contains the chromatin.

FIG. 87, *a*, *b*. Sperm. of *Forficula auricularia*—Valette, A. m. A., x.

FIG. 88, *a–d.* Sperm. of *Stenobothrus*—Valette, A. m. A., x.—The middle piece (at least its periaxial portion) is formed directly from the paranucleus.

FIG. 89, *a–g.* Sperm. of *Blatta germanica*—Valette, A. m. A., xxvii.—The paranucleus is reported as formed from a granular mass, and it evidently is built into the "middle piece." In *e* and *g* globules of cytoplasma are seen sticking to the flagellum (neck [middle piece] and tail).

FIG. 90, *a*, *b*. Sperm. of *Agrion*—Bütschli, Z. w. Z., xxi., pp. 402 and 536. *c*, *Hydrophilus*. (*Clausilia*, *Acridia*, *Clythra*, etc., agree closely with Figs. 87, 88, 89, 90.)

FIG. 91, *a–j.* Sperm. of *Astacus*—*a–g*, Grobben, A. z. I. U. W., i.; *f*, *h*, *j*, Nussbaum, A. m. A., xxiii. *j* is view from above.

FIG. 92, *a–e.* Sperm. of *Eupagurus*—Grobben, A. z. I. U. W., i.

FIG. 93, *a–d.* Sperm. of *Ascaris megalocephala*—Van Beneden, A. B., iv.—*a*, Spermatocytes forming from the spermatogonium. The two nuclei are united by the *spindle*. In *b* spermatids have formed, held together in a spermatogemme by a "cytophoral" portion (in which is a "*refringent body*" connected with each spermatid, homologous with paranucleus). *c*, the mature sperm. The nucleus is situated in the head, which is left uncovered by the thin membrane that covers the remainder. The "refringent body" is large, and fills up nearly the entire body. *d*. Here the refringent body is small, the protoplasm about the nucleus in the head, amœboid. The microsomata of the cytohyaloplasm, seen in rows, mark the nodes of a regular reticulum.

FIGS. 1–13, 25, 66–68, 71, 81, 93, illustrate the *structure of protoplasm*.

FIGS. 1, 2, 6, 16–18, 22–34, 49, 59, 66, etc., illustrate the "*individuality*" *of the nucleus* or of its subordinate parts.

FIGS. 13, 14, 17, 19, 20, 28–51, illustrate the different *forms of nuclei*.

FIGS. 8–10, 13–15, 19, 20, 26, 28, 43–47, 49–61, illustrate the *different conditions and morphological structure* the nuclein may assume aside from the changes of *karyokinesis*. Still other examples will appear when *karyokinesis* is considered.

FIGS. 50–64 (exc. 62) illustrate the *structure of the* "*germinal vesicle*."

FIGS. 66–93 illustrate the *structure of the spermatozoon*. (Only a small piece of the tail has in each case been represented, to economize space.)

FIGS. 36–40, 42, (44?), (49!), (50?), 56, 58, 64, 70, 73, 78, 80, 81, (83?), 84, 86–93, indicate the presence of a *paranucleus*. Other cases will be given under *karyokinesis* and *fertilization*.

I.—Introduction.

"WHAT is the significance of *sex?*" is a special inquiry in the more general field of research included under the head of *Reproduction;* but nearly all the problems of the larger subject must be investigated if we wish to elucidate the more special one. The question presents both morphological and physiological aspects. Thus, we need to know the intimate structure of the sexual cells in the different plants and animals and the modifications this structure undergoes from the time the cells are generated until fertilization is effected. We can in this way compare the ovum and the spermatozoon and perhaps learn whether their functions are alike or different, and in what they differ. But we must also know how they compare with other cells, and are therefore at once compelled to treat the general subject of *Cytology*. This may conveniently be done in the following order: (1) Cell-structure in general. (2) The structure of sexual cells; the ovum (practically the germinal vesicle) and the spermatozoon. (3) The phenomena of karyokinesis. (4) The phenomena of fertilization.

Then in the next place it is necessary to make a comparative study of the methods of reproduction in the groups of living beings, following the phyla of evolution. In unicellular organisms we shall be mainly interested in the various ways in which reproduction is effected and the relation of these to the action of environing circumstances. Here we may see the origin of sex and henceforth trace its evolution. Then as we see how the multicellular individual arose from the unicellular one, and as we trace the evolution of more and more complex forms, differentiating into more and more numerous groups, the relations of the sexual method to other methods of reproduction will gain in interest and be best considered under the heads of *Alternation of Generations* and of *Parthenogenesis*. We shall also be specially interested in following the genesis of the sexual cells during the life-history of each individual, and so be involved in the mazes of *ovigenesis* and *spermatogenesis*. Incidentally *hermaphroditism* should be touched, and finally the morphological side of the question must conclude with a discussion of the significance of the *polar globules* and allied points.

Then on the physiological side, there is a vast and fruitful field both of accumulated facts and promising experiments for future research. The numerical relations of the sexes under fluctuating conditions so comprehensively discussed by Düsing in his memoir on the "Regulation of the Sexual Ratio," first invite our consideration. Next we cannot escape a discussion of the problem of *Heredity*, because this is the very soul and centre of all these other problems; and finally we must necessarily conclude by discussing the doctrine of the *Genesis of Species.*

We thus see that this inquiry is one of vast proportions, and can understand why it is still unsettled, in spite of the flood of speculations that all ages have poured upon it because of its absorbing interest and importance. But all except a very few of these attempts at a solution of the problem of sex are of no scientific and only of slight historic value. We shall only attempt a summary of our *present* knowledge of the subject as a *foundation* for future progress.

The stimulus this kind of research received through the labors of Darwin has not been effected in as great a degree among English-speaking savants as with the Germans. It is desirable that more interest in this subject be awakened among American naturalists, not alone for the sake of national pride, but also because the obscure recesses of this great problem can be illuminated only by the combined labors of many minds.

The earliest thinkers, acquainted only with the highest forms of life, naturally supposed that the interaction of the two sexes was necessary to produce a new being. Some, as Hippocrates and Galen, supposed that the two parents contributed equally and in a complementary manner to this achievement; others, as Aristotle, Fabricius, Harvey, thought that one parent was subordinate in his influence, being a mere stimulus to development. The discovery of the *ovum* and *spermatozoon* gave more definiteness to these theories, and so arose the schools of the *ovulists*, who saw in the spermatozoon a fertilizing element of the ovum, and the *spermatists*, who thought the ovum or the uterus to be a *nidus* where the *spermatozoon* was nourished and developed to the new being. Advancing knowledge dispelled the latter views and modified the former, but now arose the controversy of *evolution* vs. *epigenesis*, and so for a season attention was diverted from the main problem of the significance of sex.

Spontaneous generation once accounted for the presence of the swarms of minuter forms of life, but scientific study, aided by the microscope, showed that these lower forms of life multiplied by methods obtaining with the higher forms, and the doctrine of spontaneous generation was, by Tyndall's beautiful experiments, finally banished from the realm of the minutest infusorial life,—to which, as a last resort, it had been restricted. But, with the establishment of the law that all living beings are derived from pre-existing forms of life, we also learned that another method of reproduction, the asexual (agamogenesis), was more widely used by nature than the sexual one, and increases in importance as we descend the organic phyla,—is, in fact, the foundation on which the latter rests, and out of which it has been evolved as a rare and expensive, but useful, link in *generation.*

It is now a half-century since biology received its organon in the formulation of the *cell-doctrine.* From this doctrine we must start in every biologic inquiry. Stated briefly and in the light of the present, it stands thus: The body of any of the larger plants or animals is a mass of minute units, called *cells,* that are organized in a complex way into different orders of higher units, or parts, known as *tissues* and *organs.* The unity or *individuality* of the organism is secured by the harmonious working together of its organs, like the parts of a *mechanism,* towards simple results for the good of the whole. All living beings, compared as to structure (morphology), naturally fall into groups that are related like the branches of a tree (phylogenetic classification). At the roots we place the unicellular beings, then, as we reach the lowest and least subdivided branches, we find organisms represented by simple aggregations of cells like those which lower down live as independent beings; and, as we rise along the phyla, such aggregates become more and more complex in organization. In the development (ontogeny) of an individual its organization is established in the following manner. We start with a single cell, which produces an aggregation by continued self-division, and then the units differentiate into the tissues and organs, becoming successively more and more complex, so that the embryologic history—leaving out of consideration secondary or *cenogenetic* modifications—is a repetition of the stages seen as we ascend its phylum in the natural system. Such relations as these could have been established only by the actual evolution of living beings along these lines, in the past history of the earth; and this is confirmed by the *paleontologic* record. We are thus convinced that organic beings are *genetically* related, and, therefore, the phenomena of reproduction and the question of sex must be considered in relation to the problem of the genesis of species.

The laws of organization of biologic beings find their analogues in civil and social organizations. Hence we often speak of the animal as the *cell-State.* As civilization progresses and *Society* is evolved, the unit, here the human mind, becomes more and more specialized in its activities, and the individual more and more dependent for his existence and welfare upon the fact that he is *part* of an organism,—the *State,*—which is complexly organized of many interworking and subordinate parts. How wonderful are the life manifestations of a State! and yet nothing is done except by the activities of the faculties present in each mind. The *division of labor* causes each function to be more efficiently exercised; but, what is more important, it is the *form* in which this is organized that impresses us and that makes the *individual.* In a similar way, a man may be said, philosophically speaking, to be only a developed amœba, even as a State is a man on a larger scale.

We are thus enabled to understand what is meant by the *Individual.* This term is purely relative, for in an organism where the subordinate units still retain a large measure of independence, the individuality of the lesser units detracts from that of the larger; indeed, the latter is not thoroughly established until the former is sacrificed, when the lesser units are so mutually dependent as to be mere *parts.* When this stage is reached the existence of the lesser units depends on the existence of the greater unit. Thus, when the organic relations or functions in a man's body are disturbed, not only does the man die (cease to exist) as an individual, but the cells also dissolve into the less highly organized substances of "non-living" matter. *Life* may then mean one or both of two things: 1, the activities of the organism (this is of course a mere summation of the activities of the cells); 2, the *form of organization* of these activities; this is a *relation*, an *abstraction*, but is necessary for the existence of life in the former sense,—*i.e., it makes the individual.* The controversies so often arising about these terms can only be due to a misunderstanding of the cell-doctrine.

There is, however, this difference between the *biologic* and the *social* individual,—the latter can be formed by *association* of units at first independent, while in the former *the cells are always genetically related.* The metazoa arose from the protozoa by a modification in the mode of reproduction by self-division, which caused the daughter-cells to remain united. Now, let all the other phenomena and forces remain as before, these daughters will soon divide again, they will not separate but will go on for a considerable period until an aggregate of cells results, then by the operation of the principles that produce *alternation* of *generations* in separated forms and *polymorphism* in *colonies,* there will follow what we term the *differentiation of tissues,* and lo, a metazoon. In a similar way, *among the Metazoa a multisegmented form must have arisen from one unisegmented by modified budding or strobilation.* Natural selection will account for the preservation of forms, but the cause and origin of new forms lies in the above laws of *organization.* We are now prepared for the next step in this argument. As *self-division* is the only form of reproduction that could give rise to the Metazoa, we understand why this is the mode which alone operates during ontogeny. It is also the usual mode of reproduction among the Protozoa. Once in a while under hard conditions of nutrition, etc. (perhaps so only as to its origin—Weissmann), the protozoan individual, too feeble to fight the battle of life alone, fuses (*conjugation* with a neighbor (sometimes more than one?), and thus reinvigorated goes on in its former way again. Possibly *conjugation* is only one, though the most useful, of several methods by which *rejuvenescence* can be effected; at any rate we can see that by "sexual reproduction" we do not mean a new mode of reproduction contrasted with the asexual mode, but simply *a particular mode of a sexual reproduction preceded by a particular method of rejuvenescence* (conjugation, fertilization[1]). Now when the Metazoa were formed by the non-separation of cells produced by binary division, those cells that required rejuvenescence were set free that they might conjugate, and *this is the origin of the ova and spermatozoa.* All the cells resulting from the repeated binary division of the fertilized egg are *homodynamous,* but all could not leave and be fertilized, because many were needed to differentiate into the various

[1] Van Beneden, Archives de Biologie, iv. p. 616.

tissues for the good of the whole. Even some of the generative cells had to serve their more fortunate brethren by giving origin to the accessory parts of the *generative tissues* that a few cells might be successfully prepared to perpetuate the species. All the tissues, including the *generative*, are based on a stroma of undifferentiated, "embryonic" cells, capable of dividing as they have in the past, and differentiating into their proper tissue when they have the chance, as in *regeneration* of lost parts. These cells are all the descendants of the original egg, and homodynamous with it and each other as if they were separate amœbæ. But after a certain number of divisions they lose the power of dividing further without fertilization and then they differentiate. Only the cells differentiated in the direction fitting them for fecundation ever get a chance to be fertilized.

Possibly this want of fertilization, more and more increasingly felt by the embryonic cells as they continue their final divisions, may explain *senescence*; but so long as we do not understand the nature of senescence in the Protozoa we cannot understand it in the Metazoa.

Growth is due in the Metazoa to the double process of cell-multiplication and cell-growth. May we not say that cell-growth is also partly a result of a reproductive process, and that the cell is a living unit by virtue of being organized? There can now no longer be a doubt of this. We can no longer speak of animals as "evolved from a homogeneous bit of jelly." Cells and the Protozoa and Protophyta in general, may be considered as illustrating as wide a diversity of differentiation and gradation of organization as we see exemplified in the larger units or in the social units (societies and states). We cannot conceive of life without organization. *The homogeneous cannot be called living.*

The cell-wall at first was thought of importance, but soon it was seen that this was a secreted product, and so its gelatinous contents, called *protoplasm*, next became the definition of a cell. But most cells had one or more "nuclei" in them, and this was conceived as a differentiated product of the protoplasm. Continued study of the *nucleus* raised its importance more and more, until at present some eminent cytologists are ready to make it the essential part, and the surrounding plasma almost as secondary as the cell-wall itself. Believing this to be the true view, we are ready to consider,—

II.—The Significance of the Cell-Nucleus to the Problem of Sex.

(*a*) CELL-STRUCTURE IN GENERAL.

Microscopic examination of cells in the living state, or treated by the simple *hardening*, *staining*, and *section-cutting* methods of a few years ago, can give us only a superficial knowledge of cell-structure. With such methods the first step taken was to distinguish the protoplasm as differentiated into the outer membrane or *cell-wall*, the more fluid and granular *contents*, and the generally spherical and central *nucleus*. The last body often carries a *nucleolus;* and nucleus and nucleolus may sometimes be increased in number, or, again, they may apparently dissolve to be later reconstituted. Our next step under this technique was to distinguish a primary and a secondary plasma,—the former the *protoplasm* proper, the latter the *deutoplasm* (paraplasm, metaplasm, etc.), formed by processes of *absorption*, *assimilation*, and *degradation* of the protoplasm. The former is active, *life-substance*, the latter passive, *food-substance*. The protoplasm is more firm and hyaline, abundant near the wall and the nucleus, and forms coarse trabeculæ, traversing and bathed by the deutoplasm. The latter substance is mainly "cell-sap," in which float *granules*, oil-drops, yolk-spheres, etc. The difference in the size of cells is due mainly to difference in the amount of deutoplasm they contain. We are not surprised, therefore, to learn that the yolk of a hen's egg is homologous with a microscopic cell, but we cannot say that it contains no more pure protoplasm than the latter.

The third step was taken as a result of studies of the phenomena of fertilization. The nucleus of the egg, the *germinal vesicle*, often shows a structure quite comparable to that of a "typical" cell, and the fact that it was seen to conjugate with the spermatozoon certainly pointed to its *autonomous* nature; but at first the true import of this conclusion was obscured by theories as to the multicellular nature of the ovum.

Our knowledge of the cell has, owing to improved technique, been wonderfully advanced during the last decade by the labors of cytologists, led by Strasburger and Flemming; and at present the work of Carnoy and of Gaule promises a new era in which the science of the cell shall rise to the dignity of a grand division of biology. We shall treat of *Cytology* only so far as a knowledge of it prepares us to understand the import of *fertilization* as a morphological problem.

No one cell described in detail could be taken as "typical." It would be as absurd as to describe a horse as a typical animal. But the horse has tissues which are similar to those of widely different animals. So with protoplasm; it has a typical structure generally obtaining,—viz., *it is reticulated.* The *reticulum* is easily seen in "multipolar" nerve-cells, but almost any cell, when properly treated, will reveal it. (See Figs. 1–13.) A coarse reticulum has its trabeculæ themselves more finely reticulated. The reason for this structure is obvious. The thin threads of protoplasm are bathed by the cell-sap (the *enchylema*), and so the processes of *nutrition* and of *respiration* take place with rapidity. In the protoplasmic reticulum two elements are distinguished,—the clear *hyaloplasm*, which serves as a matrix for granular bodies of various sizes,—the *microsomata.* The microsomata are formed by the growth or the fusion of exceedingly minute grains, to which the term *granules* may be restricted. Then in the nucleus, when the microsomata grow or fuse to a few larger bodies, they readily come to be designated *nucleoli.* So these terms simply refer to size and not to definite substances, for one and the same substance occurs in all these forms, and there is every reason to believe that several different kinds of protoplasm occur in the form of these microsomata.

Another distinction is also made in that the protoplasm outside the nucleus is called *cytoplasm*, and that forming the nucleus is the *karyoplasm* (nucleoplasm). From this we get the terms cyto-hyaloplasm, cytomicrosomata, cyto-enchylema, or cytenchyma; and, correspondingly, karyo-hyaloplasm (karyaloplasm), karyosomata, karenchyma. Chemically, the *karyosomata* contain "*nuclein,*" which is generally termed "*chromatin*" because of its great affinity for "stains." Gaule believes that he can differentiate two constituents of the karyosomata and two of the cytoplasm. He restricts the term chromatin to a substance having most affinity for *hæmatoxylin*, and gives the term *plasmosomata* to those nucleoli that especially fix *safranin.* The microsomata of the deutoplasm are said to especially stain by *eosin*, while *nigrosin* has a special affinity for ordinary protoplasm (cytaloplasm or cytosomata, he does not distinguish which). (See Figs. 49 *a–h.*)

It is pretty certain that protoplasmic movement is due to the alternate contraction with thickening, and stretching of the fibres of the reticulum. The nodes of the reticulum come closer together in some one direction, and get farther apart in the direction at right angles to this; at the same time the microsomata at the nodes absorb the intervening microsomata. This looks as though the matter of the microsomata was subject to mutual attractions and repulsions, and then we could say that muscular movement is a special manifestation of those varied phenomena of division and fusion, attraction and separation of microsomata seen in karyokinesis.[1] However, this generalization cannot be made so long as we are uncertain whether the hyaloplasm or the microsomata are the primary thing, or whether they are independent but mutually reciprocal. If the microsomata (granules) are primary, then we must assume that the hyaloplasm is an aggregation of a special sort of these granules in a definite way to serve a definite function. From the optical properties of the hyaloplasm this structure must be regular and uniform. Others of these granules differentiate in various directions to serve various functions, and form, by various degrees of aggregation, the different sorts and sizes of microsomata. The primary granules from which all these other forms of protoplasm in the cell are derived must be endowed with the power of *growth*, of *reproduction* by simple division, and of differentiation or variation. They would be affected by stimuli and vibrations travelling in the hyaloplasm in which they live. They should be designated *gemmules*, because of all these properties. The *cell, on this hypothesis, is a gemmule state;* it is a complex organism, with parts structured and differentiated for special ends for the good of the whole. The membranes for protection and osmosis, the reticulum for movement and transmission of sensations, the gemmule for assimilation and reproduction. Degraded gemmules like differentiated and degraded cells form the various kinds of microsomata in the deutoplasm, and build up other parts of the cell. We shall see that the facts of cell-structure, of karyokinesis, and especially of fertilization, lend great weight in favor of this hypothesis. The *gemmules are the idioplasm.* They build up the cell in its peculiar characters and maintain it there. Under the above hypothesis the theory of Nägeli as to the structure of idioplasm will apply to the struc-

[1] See Figs. 12 and 93, *d*, and consult Van Beneden, Arch. Biol., iv. p. 343, and Melland, Quar. Jour. Mic. Sc., xxv., July, 1885.

ture of the gemmule, and not to the reticulum primarily as Nägeli intended. But the discussion of this point belongs under the subject of heredity.

It may be asked, what is gained by putting back the problems of life—of assimilation, of reproduction, and of heredity—one step; are they not as inscrutable as before? Undoubtedly they are, but we gain greatly by such a view as this. We can better understand the cell. Just as we simplified the problem of *life* as applied to the higher animals, by the cell-doctrine, so we simplify by as great a step this protean problem by means of the gemmule hypothesis. We must accurately determine what are the real labors of the gemmule out of which, by organization, the more wonderful phenomena of cell-life grow, and then we shall see that we have spanned by a large fraction the chasm between non-living matter and living matter. The albumen molecule is a very minute thing when compared with the gemmule, and there is plenty of room for one or two *stadia* of organization between, that would, when known, simplify the problem completely. On this hypothesis, also, cells must have a life-history in which they pass through stages of development and stop in various degrees of complexity as mature cells. The more highly organized cells must pass through the stages in which the less highly organized remain; and there is room here also for a *phylogeny* and for *cenogenetic* modification. Finally, the simplest cells we know, must be to some extent modified from the condition in which the original cell was. This must be taken into account in trying to derive "living" protoplasm from "non-living" matter. The first gemmule could arise only by organization of a lower order of life, and the first cell must have been an aggregate of like gemmules produced by binary division of a mother gemmule. Reproduction in this hypothetical first cell we may reasonably suppose to have been effected in two ways,—either by a division of the gemmule colony into two smaller colonies, or by a dissolution of its members when each gemmule was set free to become the progenitor of its own cell-state. When differentiation came in, the primitive mode of reproduction became modified, as follows: A few only of the gemmules were kept undifferentiated for purposes of reproduction. The others had to serve these, helping them to get better chance of food by carrying the colony about by amœboid or ciliary motion; others to give protection; others, to furnish a special breeding-place for the gemmules differentiated into the nucleus; and so on. When the gemmule was set free, it more and more had to be protected by special envelopes, and so arose spores. When all the gemmules free for reproductive purposes went into the spores, the protoplasm remaining after the spores were set free could no longer grow, and hence live, and thus in reproduction by spores, as in gregarines, the mother-cell was left as a *corpse* when this sort of reproduction was exercised. (Fig. 27, *e.*)

But reproduction by binary division still continued, modified first as budding, where some of the reproductive gemmules were pinched off with a share of the cytoptasm. Here we must call attention to the fact that the *individuality of the cell does not depend on the number of idioplasm gemmules in it*, for all these, being undifferentiated, are, as it were, embryonic or *alike* and *mutually autonomous.*[1] They continually grow and divide, and two, resulting from one, do not produce a different kind of effect, but only more work than one. Indeed, the effect produced is not seen until they differentiate, and so present the characteristics of the cell. *This principle is extremely important for understanding the facts of fertilization.* It makes no difference whether the reproductive element set free contains *one or a million* gemmules, except that in the former case it *takes longer* to make as large a cell as the mother; in precisely the same way as it takes longer to raise a hydra from the unicellular egg than it does from the multicellular bud. The reproductive gemmules being now confined to the nucleus, binary division resulted in nuclear division; so far as it was advantageous that a large plasmodium-like cell should be produced, the new nuclei remained and nourished the common cell; and so far as the spreading of the cell over the habitat was of advantage, each daughter-nucleus took its half of the cytoplasm, thus producing cell division. This subject will be continued under the head of Karyokinesis. Continued binary division of the nucleus and the development of the products while the mother-cell remains undivided results in *free cell formation* (at least one variety of this). These cells often play the rôle of spores, and what is of importance when this is the case, the size of the spore is reduced in proportion to their number,—*i.e.*, to the number of divisions. In a number of the monads these spores are so

[1] Compare Nussbaum, Arch. f. Mic. Anat., xxvi.

minute as to be visible, only as a cloud of refringent points, under a magnifying power of four thousand diameters. (See *Roy. Micr. Journ.*, April, 1886.) Dallinger saw these points grow until they attained the size of nuclei, then there was differentiated a narrow zone, which increased in width around the nucleus and formed the cell. At the time this zone first appeared the hitherto homogeneous nucleus differentiated microsomata within it. (See Fig. 98, *a–e*.) As the flagellates seem to be the lowest of the forms of life in which all other groups converge, we should expect here the most primitive methods of reproduction. This mode of spore formation follows conjugation: the nucleus spreads by a sort of dissolution through the plasma as in the case of the cyst forms. When the latter is broken, these spores imbedded in a plasma fill it. Have we not here a direct reduction to the gemmule condition, each gemmule being given a chance to start a new cell, *i.e.* a gemmule colony?

From the simple modes indicated above, we can easily derive the methods of reproduction obtaining among the Protozoa. If the whole or a part of the nucleus segments into spores which remain in a "brood pouch" in the cell-body, and are liberated as motile young, we get the "*germ balls*" of Stein. Compare Figs. 22, *d*, 23, 29, 30, 32, 33, 34. The structures here indicated are similar, but in many cases these nucleated bodies simply represent a stage of development or of kinesis of the nucleus, and are not liberated as spores. Bütschli is inclined to disbelieve in this mode of reproduction, but it hardly seems as if his objections sufficiently disprove the evidence we have of its existence.

If the chromatin, instead of remaining uniformly distributed in the nucleus, gathers into a particular body, which sustains the relation of a nucleus to the old nucleus, we get a *nucleolus*. This is a structure very generally found, especially in highly developed cells. The nucleolus is to be conceived as the primary body and the nucleus as secondary. Before the nucleus can divide the nucleolus must divide; but here we may get multinucleolated nuclei by the multiplication of the latter, while the former remains undivided. The general law of cell-life seems to be to conserve in the centre of protoplasmic bodies a supply of undifferentiated or primary substance (the *idioplasm*), and to surround this by concentric structures that protect it, and serve as organs of relation to the external world. The external envelopes are derived by differentiation of this inmost substance. This idioplasm is continually throwing off centrifugally these secondary substances, and the continued life of the cell depends on its integrity. Reproduction always means that a portion of this substance has been separated from the remainder, and so acts from a new centre. The secondary plasmas are *mechanisms* for effecting such separations, as well as organs for other purposes. *Alt the biological manifestations of cell-life are due to the activity of these organs.* All the idioplasm does is to *grow*, by the growth and continual division of its gemmules, and to *differentiate*, by *organizing* in various relations for the different organs, perhaps accompanied by the chemical degradation of the units. What the chemical processes are that take place in the idioplasm unit, by which it grows and reproduces, must be referred for discussion to the subject of *Heredity*. The above is not an explanation, but simply a statement of the facts of heredity, as we conceive them, in this connection.

The forces active in the gemmule are, of course, the primary cause, and the reason for and explanation of the activities of the secondary plasmas, which activities are, as was said above, the phenomena studied in biology.

We can understand, in this light, how we always have structures and processes that obtain in one stadium of organization repeated in the higher, compound, or derived stadia. For this reason the nucleus is, when far enough developed, reticulated like the cell, and the nucleolus itself often repeats the structure. (See Figs. 2–13.) In the same way as we get three concentric structures simultaneously existing (Figs. 9, 13–15, 19–22, 26, 32, 42, 44, 49, 50–64), we may have a quadruple condition (presenting one or more nucleoli in the nucleolus), seen in Figs. 13, 26, *f*, 27, 33, 51, 53, 56, 58, 64; and possibly Fig. 56 is evidence of a quintuple state. The central body is always capable of generating the whole cell by a differentiation of its chromatin (see Fig. 49), and the central body of this new cell has like powers, and so on indefinitely.

We often have the nucleus or the nucleolus dividing into parts that are of unequal value, thus giving *chief* and *accessory* nuclei or nucleoli, as the case may be. (See Figs. 44, 49, 51, etc.) In this case the chief body only retains the reproductive function, and can, by suitable stains, be differentiated from the accessory bodies. In this way Carnoy and Gaule have shown that such stains as hæmatoxylin and carmine are not tests for chromatin in a restricted sense, but that we must use safranin and methyl green. It is indeed a remarkable property of the idioplasm that it has a special affinity for aniline dyes.

In connection with the segmentation of the chromatin comes up the question of individuality. Is a multinucleated cell a single cell? If we understand that the chromatin is composed of many small units, like the soldiers in an army, we see that it can divide into bodies of various sizes, and these bodies can fuse again, just as the different divisions of an army may combine for any operation and separate once more for other duties. Such phenomena of the multiplication of centres of chromatin activity are illustrated in Figs. 1, 24, 25, 31, 42, and 48, or by a colony of flagellates, of hydroids, or by a tree.

Are all the bodies we see, such as nucleoli and granules in a nucleus, the result of *binary* divisions or of simultaneous segmentation of a single nucleolus, or are they produced by a sort of general dissolution? Conversely, what are the laws by which the different orders of bodies from granules to nucleoli are built up? This question is to a large extent obscure as yet. The phenomena to be explained in this connection are illustrated by Figs. 14, 15, 19, 26, 50–63. Even nuclei fuse (as see Figs. 94 and 97, *c*), and the sexual nuclei.

In some low forms of cells and in higher cells degraded by parasitism, such as yeasts and moulds, the nucleus may never take on the form of a compact body, but be present in the protoplasm in a diffused or granular condition. (See Figs. 14 and 15.) In karyokinesis and in maturation or development of nuclei, there seem to be phases in which this condition is represented.

Finally, we consider those forms of nuclei and of nucleoli where the spherical or elliptical shape is departed from to a large extent. Such are the *filamentous nuclei.* These are usually moniliform, being due to incomplete segmentation and to growth in one direction. (See Figs. 7, 19, *d*, 20, *b*, *c*, 28, 30, *b*, 31, 41, and 42.) In the higher tissue-cells, the *chief nucleolus* is present in this form, often being exceedingly long, and wound about in a way so as to give a reticulated appearance to the chromatin. It has been termed the *knäuel* by the Germans, which term means a *tangle*, usually termed a "skein" in English works on karyokinesis. (See Figs. 13, 19, *b*, 43, 44, 45, 46, *a–d*, 47, etc.) In Figs. 13 and 47 we see the chromatin present in these filamentous nucleoli has been complexly arranged in a reticulum and in a spiral respectively. A cross-section of one of these filaments (mitom of Flemming) cannot be distinguished from a section of a spherical nucleolus of like structure.

[NOTE.—After the above article left my hands an important paper by Altmann ("Studien über die Zelle," Leipzig, 1886) came to my notice. By means of fuchsin staining, followed by a wash of picric acid, a new element, the "*granula*," is brought to notice in the cytenchyma. These *granules* have hitherto been included with the cytenchyma in the general term *deutoplasm*, but Altmann believes they should be elevated to the dignity of an element in the protoplasm. To them Altmann ascribes the function of initiating and sustaining the metabolic or vegetative activities of the cell, while the reticulum mediates the motile functions. Morphologically, they are seen to grow and to multiply by fission or budding, so that he has formulated the law "*omnis granula e granulo*." He conceives the nucleus and nucleoli to be aggregations of granules, as are also the chlorophyl-corpuscles. (Compare Schimper, *Botanische Zeitung*, 1880 and 1883.) All this falls into line with the gemmule hypothesis, but the function of these granules cannot be so primary as he believes, if we are to credit the evidence obtained from experiments on enucleating cells. (See Nussbaum, A. m. A., xxvi.) Nussbaum found that if he cut an *Opalina* to pieces, the pieces deprived of nuclei continued to manifest movement, but did not grow. On the other hand, those pieces that had nuclei regenerated their lost parts. It is worthy of note that if a new formation was once in process of development, this was completed, even though the piece was enucleated during the process. This can be understood if we suppose that gemmules destined to repair the tissues had already migrated from the nucleus, though, of course, we are not confined to this explanation.]

(*b*) STRUCTURE OF THE SEXUAL CELLS.

In speaking of the sexual cells without distinguishing the ovum from the spermatozoon, it is useful to use the word *gamete*, from which we readily coin another useful word, *gametogenesis*, as including *ovigenesis* and *spermatogenesis*. In the present section we are concerned only with the changes which the nucleus of the gamete suffers after its final division in gametogenesis.

It is well known that in the earliest stages of gametogenesis there is little, if any, distinction between male and female cells; that in many cases the cell boundaries are not distinct, but we have a homogeneous albumen containing scattered nuclei, recalling a *syncytium;* that these nuclei have sometimes been seen to multiply by budding or by direct division; that the nuclei, as they grow, lose their homogeneity, and differentiate a reticulum and nucleoli in their interior, and simultaneously a layer of protoplasm, thin at first, grows out as an envelope about them, much as in Dallinger's *monad.* (See *J. R. M. S.*, July, 1886, and Fig. 98.) When the cells are completed, they multiply by indirect division (karyokinesis), but not to a very great extent, if destined to become ova. In this case a period of growth, of storage of nutriment for the future embryo, ensues, and when this work is completed, the ovum shows its homodynamous nature with the spermatozoon by completing its delayed divisions by the formation of the *polar globules.* Why these divisions are thus delayed will be discussed in its proper place.

If the ovum has its special work to do, division of labor has also given the spermatozoon its special work. For the large and stationary ovum must be sought out and penetrated, and so the enveloping cytoplasm is built up into the proper locomotor organs, which gives the male cell its characteristic and varied forms. We see that the characters which distinguish the male from the female gamete, or *vice versa*, are purely secondary and acquired characters, and, in the absence of these, we would be unable to distinguish sex. We shall endeavor to show that *the chromatin is not sexed*, but probably differs in the two cells by an infinitesimal variation. *So far as our idea of sex implies the differentiation of* MALE *from* FEMALE, *the chromatin is not sexed, but so far as it implies* DESIRE FOR CONJUGATION *with other chromatin differing from it by a slight variation, and likewise filled with a longing for conjugation, it* (the chromatin) *is sexed, but to this idea of sex the thought of male and female is foreign. Male* and *female* are ideas that have arisen in contemplating the different secondary mechanisms that have been evolved for the purpose of effecting conjugation; and these characters are the result of the operation of the same principles that have differentiated a gland-cell from an epithelium-cell.

But, let us see how these secondary or sexual mechanisms differ, and how the nucleus is related to them. We first consider the changes that are suffered by the nucleus of

THE OVUM.

Most of the observations on the *germinal vesicle* (nucleus of the ovum) relate to its behavior in relation to the polar globules, which does not now concern us; for we now know that this is simply the nucleus dividing by karyokinesis so as to become sexually mature, and that, as in ordinary karyokinesis, the successive halves of the nucleus left in the yelk are the homologues of those extruded in the globules. We shall show that they are all *equivalents*, and there is not a separation of "male protoplasm" from "female protoplasm" in a once "hermaphrodite" cell.

When the few observations we have of the germinal vesicle during the period of growth are compared, we are struck by the apparent variety in the different cases. But this variety is probably due in part to a real variety in nature, and in part to the limited and partial knowledge we have acquired. From a comparison of Figs. 50–64, we may gather the following general features:

1. There is a richness of chromatin development resulting in great increase in size of the nucleus.

2. There is a considerable number of nucleoli developed.

3. A large portion of the chromatin is broken down and transformed into yelk. (See Fig. 50.)

4. The boundaries of the nucleus are often broken down or obscured; if not, they remain extremely distinct, enclosing a large cavity comparatively free from chromatin, and hence the name germinal *vesicle*. But with either change we find that one of the nucleoli has taken on functions that are probably nuclear in nature, and this has given countenance to the notion that the germinal vesicle may not be a nucleus, but is a cell. Such an assumption of the nuclear functions by a chief nucleolus is repeated over and over again in gland-cells, as in Fig. 49. We thus have a chief nucleolus or *germinal dot* and one or more paranucleoli. The latter simply break down, while the former furnishes the chromatin that divides in the polar globules, and at last conjugates with the male pronucleus; so that we always have a mass of the proto-substance conserved to carry on the existence of the gemmule colony, however much of the chromatin may be used for other purposes, and this reproductive substance is always conserved in the centre of the mechanism, surrounded and protected by at least two envelopes. If the nucleus buds, it produces *paranuclei*. Perhaps this is only a peculiar method of giving off nutritive substances to the cytoplasm. We must here observe that paranuclei, wherever found, are not necessarily homologous structures, either if more than one be found in the same cell or still less where we deal with phylogenetically

widely separated cells. When the germinal dot enters upon its activities as a nucleus it passes through the stages of differentiating a reticulum and nucleoli of different kinds in itself, as we shall see under *karyokinesis*.

(*c*) THE SPERMATOZOON.

When the last division of the spermatocytes has taken place, the nucleus is practically ready for conjugation; hence, that its chromatin may meet the chromatin of the ovum, the secondary or *achromatic* structures of the nucleus transform themselves together with the cytoplasm (which seems to play a more passive part), into the suitable mechanism for effecting the transfer. In most cases the resulting form is filamentous, and has a spiral structure in some part. (See Figs. 66–93.) In such highly complex spermatozoa we may distinguish the following parts:

An outer *membrane*, which is perhaps the relic of the cell-membrane. A *head-cap*, posterior to which lies the *chromatin*. An *axial filament*, which may be taken as a sort of skeleton. (See Fig. 78, *e*.) Finally, there is a medullary sheath, best, sometimes only, developed in the "*neck*" or middle piece of the spermatozoon. This sheath is often composed of two or three bands that have been spirally twisted in opposite directions around the axial filament. Often one of the three is free and hung by a delicate mesentery, and thus may propel the spermatozoon like a screw. In the development of these parts, we first see the nucleus change its shape and become homogeneous, then the axial filament is seen stretching away from the nucleus and pushing the cytoplasm before it posteriorly as the nucleus does at the anterior end. The achromatic part of the nucleus is usually present as a paranucleus (see karyokinesis, Fig. 123, also Fig. 81), which in some cases is directly converted into the medullary sheath. Paranuclei (or granules) of a different sort are often present, and may have something to do in building the axial filament. All growth takes place in the neck just behind the head; and from this point the tail end is gradually pushed out as a completed structure. These accessory parts having accomplished their work of transferring the chromatin, which is to form the male pronucleus, are lost or dissolved in various ways. The chromatin is the essential substance, as we shall learn under "*Fertilization*."

The development of the spermatozoa in the special cases may be learned by a study of the figures (Plate IV.) with the accompanying explanations. We could now pass on to the subject of fertilization did we not have connected with this phenomena another series of phenomena that can be understood only by reference to the facts of "cell division," to which we next direct our attention.

(To be continued.)

DESCRIPTION OF A NEW SPECIES OF DIPODOMYS, WITH SOME ACCOUNT OF ITS HABITS.

BY F. STEPHENS.

Dipodomys deserti STEPHENS, n. s. Desert Pocket-Rat.

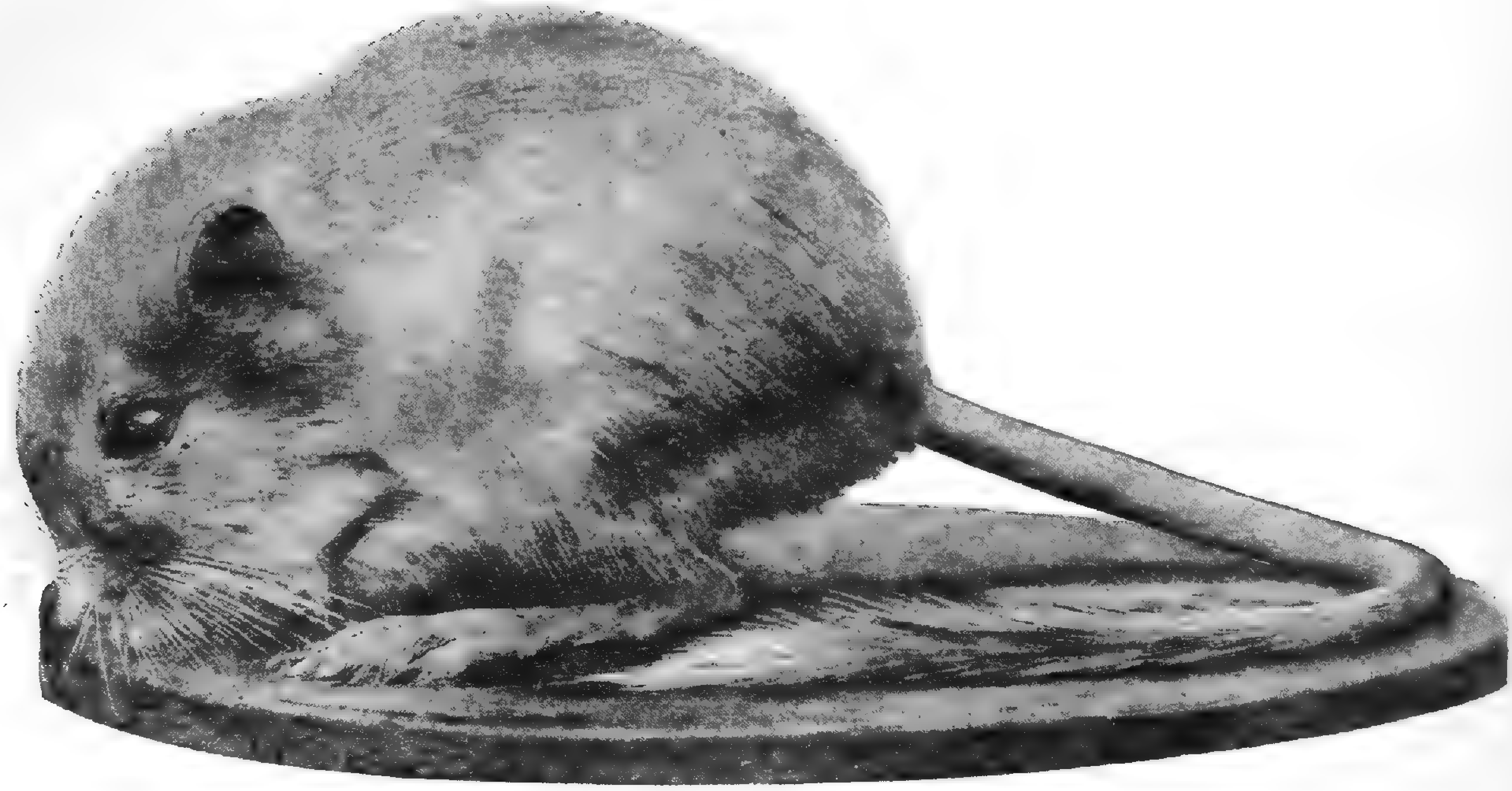
LARGEST known species of the genus. Length, head and body, 5.2 inches; tail vertebræ, 7.7 inches; hind foot, including claw, 1.9 inches. Color above pale yellowish brown, fur plumbeous at base, showing through the tips enough to give an ashy tinge. Below, white. Fore legs from elbow, and hind legs, in front, from knee, white. Tail, at base, on sides, below, and the tip, white; above, pale brown, becoming plumbeous towards the white tip. Indistinct white spot over the eye, another behind the ear, which extends across the shoulder to the white underparts. Indistinct white band across the hips. Indistinct darker spot at base of whiskers. Soles of hind feet nearly white. Type No. 314. Female, June 29, 1886. Mojave River, Cal. Deposited in the National Museum.

Habitat, Mojave and Colorado Desert regions of Southeastern California.

COMPARISON OF THE SPECIES.

Dipodomys deserti.	*Dipodomys phillipsi.*
Size large.	Size small.
Color pale, markings comparatively indistinct.	Color dark, markings distinct.
Eyes moderately large.	Eyes very large.
Soles of hind feet white in the young, indistinctly brownish in the adults, perhaps due to soiling.	Soles of feet dark brown (same color as upper surface of tail).
Spot at base of whiskers merely darker than surrounding parts.	Spot at base of whiskers nearly black.
Mastoid region enormously inflated.	Mastoid region comparatively moderately inflated.

PLATE V.



Dipodomys deserti Stephens. Desert Pocket Rat. Three-fourths natural size.
From photograph from life.

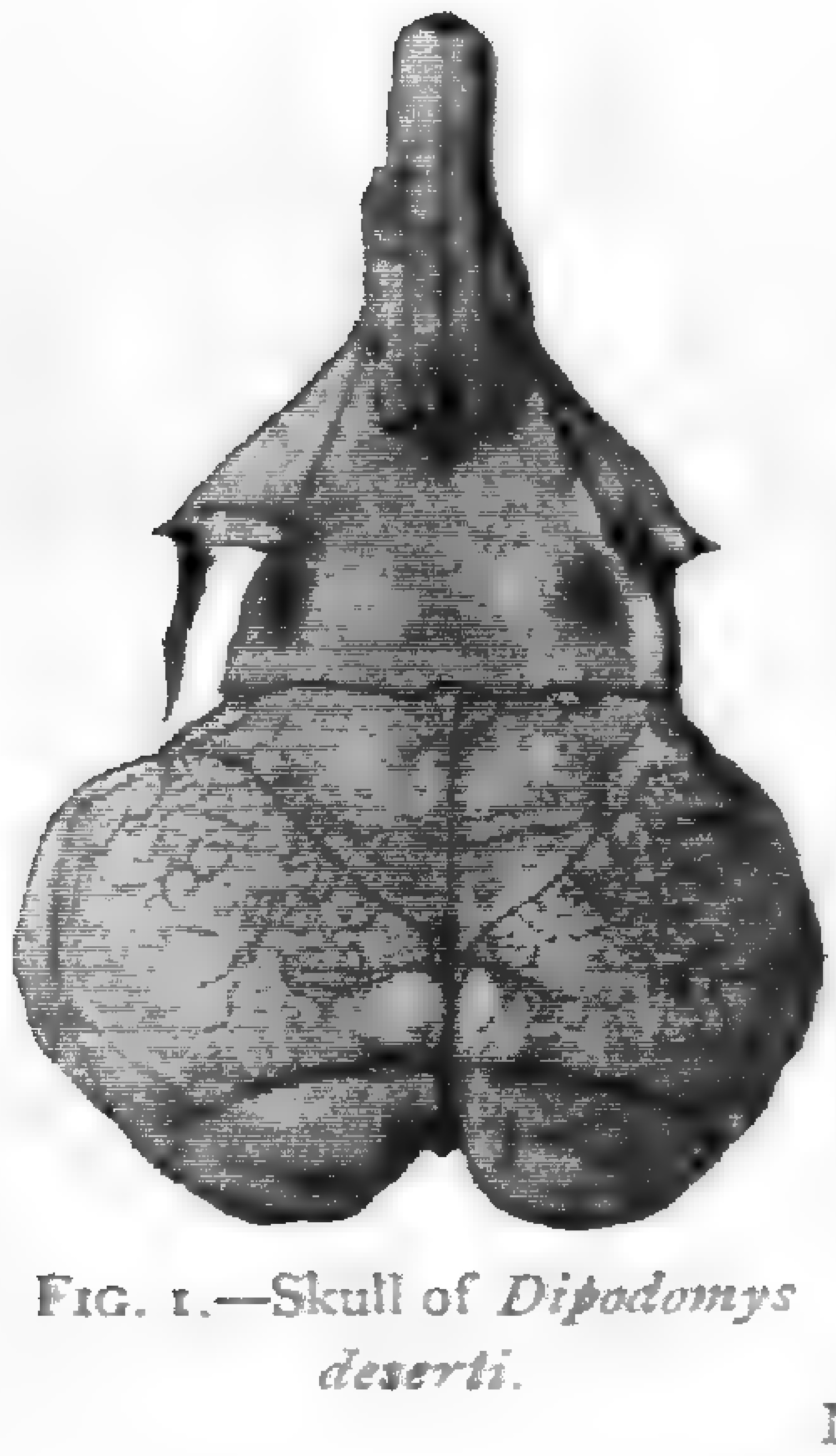


FIG. 1.—Skull of *Dipodomys deserti*.

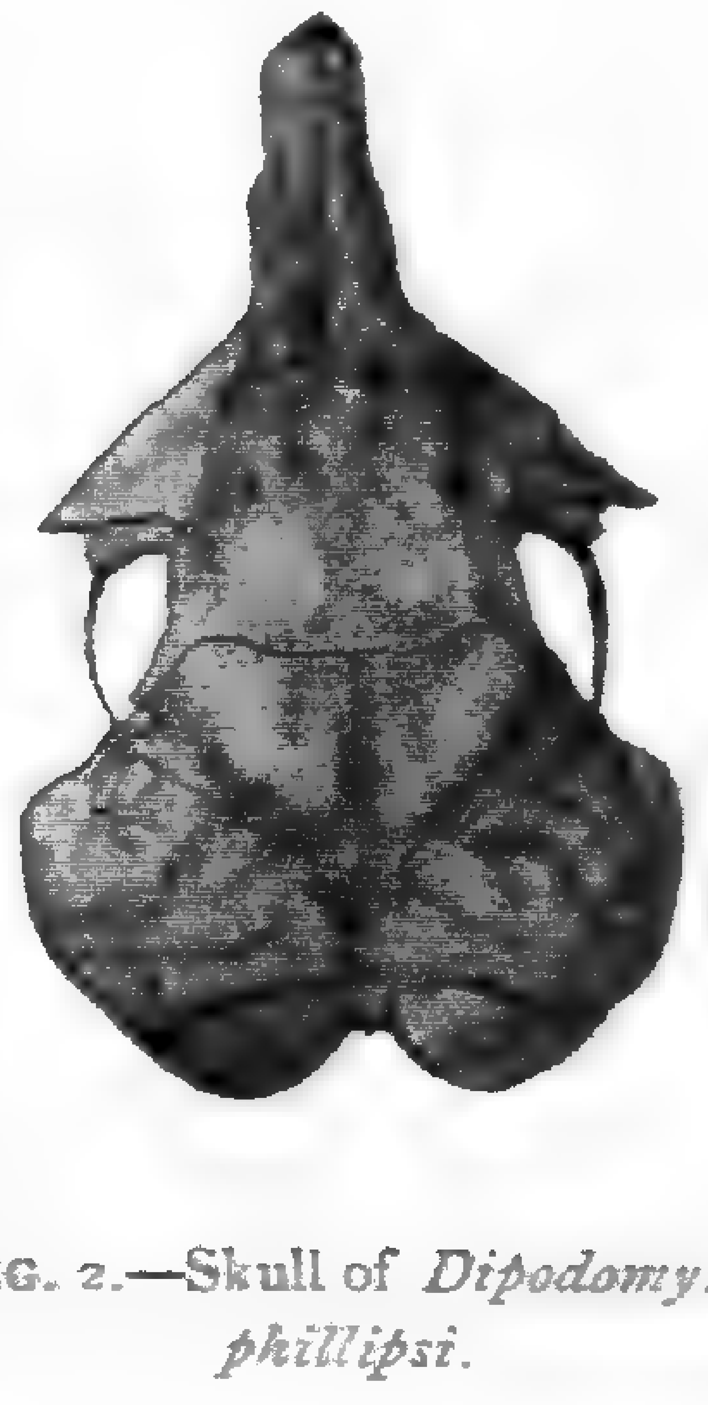


FIG. 2.—Skull of *Dipodomys phillipsi*.

Natural size.

The proportions of the two species are much the same. There are other points of difference in the skull, but this is sufficient to show their specific distinctness.

D. phillipsi ordi, being a slightly larger, rufous-tinged variety of *D. phillipsi*, may be considered as being classed with the latter in the above comparison.

The type specimen may be below the average size. I have a male that measured (fresh) 5.8 inches head and body, 8.2 inches tail vertebræ. Total number of specimens examined is nine. The photographs of skulls are natural size; of the animal, three-fourths natural size.

The last three days of June, 1886, I camped near the Mojave River on my way home from a collecting trip along the desert side of the San Bernardino Mountains. The first morning there (June 29) I found two peculiar *Dipodomys* in traps I had set the previous evening. They seemed to be a pale variety of *D. phillipsi*, such as I knew to be liable to occur there, it being the rule that most birds and mammals inhabiting the Mojave and Colorado Deserts are paler in color than others of the same species found in the moister coast region. In another trap was an ungrown *D. phillipsi* of nearly normal color, but I laid its darker color to its evident immature condition. At sunset I again put out my traps, and, as there were more inhabited burrows than I had traps for, I put out poisoned wheat also, which proved a most unwise act. This poisoned wheat is widely used in California to destroy ground-squirrels, pocket-rats, and similar pests. When it is used, some of the poisoned animals come to the surface to die, and I expected to obtain some additional specimens by its use. The next morning I had one *D. phillipsi* and two of the pale variety in my traps, and I found one of each phase of coloration poisoned, and, later in the day, when the hot sun had spoiled it, I found another pale one. Nearly all the poisoned wheat had been taken. These additional specimens convinced me that the pale animals were a good species.

I had intended driving on in the afternoon, but I concluded to stop another night to try for more. The poisoned wheat had done its work only too well, for my traps contained no pocket-rats the next morning, and but few burrows showed signs of occupancy. I was unable to revisit the region until the next November, when I followed the Mojave River for twenty-five miles from where it leaves the mountains, but succeeded in finding no more colonies, though several miners whom I met knew the animal, and thought they were not rare. From the colony found in June I obtained three *D. phillipsi* and three more of the new species, which I have named *Dipodomys deserti.* As the river was now dry in this part of its course, I was able to spend but two nights at the place. The colony appeared to be nearly deserted, but I do not think I obtained them all. I brought two animals of each species home alive, and still have them in captivity. On my way home I camped one night in the Cajon Pass, at an altitude of about three thousand five hundred feet. The night was very cold for this region, ice forming in my canteen and coffee-pot. The *D. deserti* suffered badly. I had not expected so severe a night, and had given them no protection more than to turn the open side of the box (which was covered with wire netting) to another box. At sunrise I noticed that one of the *D. deserti* seemed uneasy, and a closer inspection showed that its tail was frozen as stiff as a stick. In turning about in its narrow quarters it had broken off about two inches of the tail, the piece lying on the floor. The other *D. deserti* had not suffered so much, but it ultimately lost most of the terminal white tuft. The *D. phillipsi* seemed none the worse for the frost, and probably are a hardier race, which may account for their wider distribution.

The following notes on habits are based mainly on observations of my captives. The *D. deserti* especially have become very interesting pets, and allow handling freely. I often turn them loose in a room of my house, usually but one at a time, as they are somewhat quarrelsome, especially the one with the frosted tail, the accident having made it somewhat bad-tempered. It is quite pugnacious, driving the others about so that they often return to their cages. The *D. phillipsi* do not pay much attention to the peaceable *D. deserti*, but when the other comes near they promptly leap away. When the two species were first turned loose together they had an all-round fight, but the riot did not last long, the heavier *D. deserti* being easily victorious. The actions of both species in fighting are much alike. When both are disposed to stand their ground they stand nearly erect, facing one another, and apparently cuff and scratch with the fore feet, the motions being too quick to follow accurately with the eye. A few passes and one or the other loses its balance and leaps away, followed a short distance by the other. I have been unable to detect any use of the teeth in such face-to-face encounters. Sometimes the larger *D. deserti* will happen near one of the others and slowly and slyly work closer, and suddenly pounce on the other, when I have heard a squeak of pain as if the teeth had been used. The bite cannot be severe, for the mouth is not capable of opening widely, and the upper incisors slope inward so much that they can get but a shallow hold. I have not handled the *D. phillipsi* much, but they have never bitten me. I handle the *D. deserti* often; one has never bitten me, the other but once, when I attempted to hold it against its wishes. It bit the inside of my forefinger where the skin was thick, and though the teeth met, but a drop or two of blood flowed. The punctures made by the upper and under incisors were but five-thirty-seconds of an inch apart, and I believe it was about as hard a bite as the beast was able to inflict on so comparatively flat a surface. Of course they are capable of cutting a twig or similar hard substance of small size. They have not so far attempted to bite the tail of another, which is the favorite mode of attack of their relatives, the tuft-tailed pocket-mice (*Perognathus penicillatus*). Locomotion is similar with both species, but *D. phillipsi* is more agile, leaping farther and quicker. This species can reach to about eighteen inches from the floor in trying to escape from the room, the leap taking place from near the foot of the wall. I think the usual horizontal leap when running rapidly is three feet or more, which is considerably more than that of *D. deserti.* The gait might be termed a hop, the work being mostly done with the hinder limbs. When moving about slowly, the first movement seems to be a tap on the ground with the fore feet to raise the fore part of the body to a leaping position, when the powerful hinder limbs give a spring resulting in a leap of a few inches. When they are running rapidly one cannot see just how it is done, but I often thought that the fore limbs take little or no part in the action, which seems to be aided by the long tail, both in guiding and balancing. It certainly looks as if the animal would be in danger of running its nose in the ground and "ending over" if it depended on its very short fore legs to raise its body into leaping position after each quick leap, for *D. phillipsi* at least can get over the ground at a pace that would put a cat to nearly its best speed to overtake it. I once saw a *D. phillipsi* run some forty or fifty yards in broad daylight, and have often seen them skurry away from camp in the moonlight when I happened to alarm them by some movement.

In places where much camping is done, such as by springs on the principal roads from one mining camp to another, the pocket-rats are in the habit of coming about the wagons at night to pick up the grain scattered by the horses, etc., becoming comparatively tame, as no one harms them. I never knew a dog to catch one, for they can get under way very quickly, and in such places they have many holes, perhaps for such emergencies, and they immediately vanish in the nearest. In feeding they often rise to a more or less erect posture, apparently to get a better view of their surroundings. In the house I have seen them stand erect on the tail and the toes of the hind feet, thus forming a secure tripod; at such times they walk about several steps, sidewise as well as forward, with as much ease as a man.

D. phillipsi is the shyest; they dislike to be handled, and do not often come near me when out in the room. *D. deserti* does not seem to dislike handling, but they will not yet come to me when called, though when running about the room they pay no attention to me, running across my feet, etc. Sometimes when I come in the room they will presently come quite close to me, apparently from a mild curiosity to see what I am doing. They appear to be almost devoid of fear of other animals. The first time I put the cat in the room they came to the front, putting their noses against the wire netting to look at the cat, which was greatly vexed that she could not get at them. In this instance the *D. phillipsi* remained at the back of their cages.

So far none of my captives will drink water. They will eat of vegetables, such as sweet potatoes, the leaves of beets and cabbages. It is probable that they obtain sufficient moisture from such sources. The principal food seems to be seed and grain. They consume but little more than a heaping tablespoonful each of wheat or barley in twenty-four hours, and one or two square inches of beet or cabbage leaves, so they are not heavy eaters. For the first two or three days I had them they probably ate double this amount, but as they had been on short allowance for some weeks they were more than usually hungry. The seeds on which they depend in a state of nature had been ripe some months and naturally were pretty well gathered in, but this colony had depended considerably on the waste of the travellers who usually camped in the immediate vicinity. The travel had ceased in July when the stream dried up, and thus compelled the use of a longer route until the winter rains should start the stream running again. This hunger may have caused them to tame quicker. I heard the trap-door fall when the first one was caught, and immediately took it out and put it in a cage and gave it grain. It was amusing to see the eagerness with which it immediately went to filling its pockets. It stuffed them so full that it must have been positively painful, and then it would not stop to eat, but hunted about for some exit; not finding one, it ejected the contents of its pockets in a corner out of the firelight and went back for more. This time it ate a little, but soon gathered the remainder and deposited it with the first. After eating a little more, it refilled its pockets and hunted about for a better place to make a *cache*, seeming to think its first choice insecure. These actions plainly show that they are in the habit of storing away their surplus. In grain-fields infested by *D. phillipsi*, the plough will often turn up a deposit of a pint or so when the field is ploughed for re-seeding. The loss to farmers is thus quite considerable at times.

Having watched them repeatedly, I can say positively that the pockets are filled with the fore feet used as hands. When placed at a pile of grain, when hungry, they fill the pockets very quickly, both pockets being filled alike. The two pockets of *D. deserti* will hold a heaping tablespoonful of grain, and are, therefore, capable of carrying nearly a full day's supplies. The filling is done so rapidly that, where a hard grain like wheat is used, a continuous rattling sound is made. The ejecting of the grain from the pockets is aided by a forward, squeezing motion of the fore feet, each foot making two or three quick forward passes occupying scarcely a second of time. For the first few days all grain put in the cages was immediately pocketed, but since then they rarely fill their pockets, seeming to have found its uselessness.

The position at rest is a curious one. At first the animal stands on all four feet, with the entire sole of the hind feet resting on the ground, some of the weight coming on the fore feet; presently the hind feet will hitch forward until the centre of the hind feet comes under the centre of gravity, thus taking all the weight; then, often, the fore part of the body will be slightly raised and the fore feet drawn up against the body. If disposed to sleep, the bright eyes will slowly close, the fore feet droop until touching the ground, the nose slowly comes down and backward until resting between the toes of the hind feet, and the now sleeping animal is nearly as round as a ball. This appears to be the common sleeping posture. If there be room, the tail will be extended back nearly in a straight line, but in cramped quarters it will be curved to one side or even alongside the body; but in either case the basal part will be curved back enough to give some support. These animals make much use of the tail, and its loss would be a great inconvenience. When one of my *D. deserti* lost the use of its tail temporarily through its being frozen, I saw it fall over several times, lacking its accustomed support.

I do not see them make much use of the power of scent, but the long whiskers are very sensitive, and must be of much use in their nocturnal rambles. The sight is good in daylight, though they do not like a strong light. If compelled to rest in a light place, they face away from the light if possible. Both species of *Dipodomys* seldom emerge from their burrows until the evening light gets dim. The hearing does not seem to be unusually acute, but I have made no experiments yet to positively determine the fact.

Phillips's pocket-rat does not seem to live in companies, though the holes of different individuals may be but a few yards apart. From such information as I can gather, and from what I have seen myself, I think that the desert pocket-rat lives in colonies often if not usually. The only place where I have taken *D. deserti* has a colony of several groups of holes, each group being from two to eight entrances to a set of intercommunicating galleries, from six to thirty inches below the surface, and being within a space of two to three yards square. None that I opened proved to be inhabited. In each several galleries terminated one to two feet from the surface in a slight enlargement, which generally contained the hulls of barley, etc., as if they were used as places of storage. Two contained a little dry grass, as if they had been used as nests. I put paper and cotton in the cages, but the *D. deserti* made but little use of it. The *D. phillipsi*, however, made a rude nest of theirs. After I had the animals a few days I gave them a little dry earth. The *D. deserti*, especially, were pleased with it, rolling in it, pushing along on their bellies, and enjoying a good dust-bath. They looked much better for it, the pelage, which had been rough, becoming smooth and glossy.

I think they must sometimes eat insects, as I saw one, when hopping about the floor, come across a cricket, which it appeared to leap upon, and, as I could find nothing more of the cricket, I think the pocket-rat must have eaten it.

None of the females that I obtained contained embryos, but I have a skin of a *D. deserti* some four or five weeks old, killed with a whip by a teamster near Seven Palms, on the Colorado Desert, April 1, 1886. A friend has two young *D. phillipsi* in alcohol, taken in October, which were some five or six weeks old when taken.

I think *D. deserti* will prove to be commonly distributed over most of the Mojave and Colorado Deserts west of the Colorado River, and possibly they may occur in Arizona and Mexico.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

THIS series of articles, which should be rather entitled notes on than history of cultivated vegetables, is intended as a portion of a study into the extent of variation that has been produced in plants through cultivation. The author has had the great advantage of opportunity of studying the growing specimens in nearly all the species named, and in nearly all the varieties now known to our seed trade; and this study has given him confidence in the establishing of synonymy, as oftentimes the variables within types have furnished clues of importance. The treatment, as a matter of convenience, is arranged alphabetically, and includes the species recognized by Vilmorin-Andrieux in their standard work "Les Plantes Potagères," 1883, and the English edition "The Vegetable Garden," 1885, with the exception of the

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Pineapple and Strawberry, species which by American gardeners are included among fruits. In the matter of references the citations are all taken directly from the sources indicated, quoted references being in all cases so acknowledged in the notes. In a work of this character, where the conclusions can oftentimes seem questionable, it is important that facilities for corroboration should be freely offered, hence I have made my references to editions and pages.

AFRICAN VALERIAN. *Valeriana cornucopiæ* L.

The African valerian is a recent introduction to gardens, and furnishes in its leaves salad of excellent quality. The plant is native to the Mediterranean region, in grain-fields in waste places. C. Bauhin,[1] in 1596, speaks of it as if of recent introduction to botanical gardens in his time, and Clusius,[2] in 1601, J. Bauhin,[3] in 1651, and Ray,[4] in 1686, all describe it.

It is not spoken of as under cultivation in Miller's Dictionary, 1807, nor does Don in his "Gardeners' Dictionary," 1834, speak of any use, although he is usually very ready with such information. In 1841 the "Bon Jardinier" in France refers to it as being a good salad plant. As neither Noisette,[5] 1830, nor Petit,[6] 1826, nor Pirolle,[7] 1824, mention it, we may assume that it had not entered the vegetable garden at these dates. In 1863, Burr[8] describes it among American garden vegetables, as does Vilmorin[9] in France in 1883, and in England in 1885.

No varieties are described, although a purple- and a white-flowered form are mentioned by Bauhin as occurring in the wild plant. The one sort now described has pink- or rose-colored flowers.

The vernacular names, as given by Vilmorin, are: English, *African Valerian;* French, *Valêriane d'Alger, Corne d'abondance;* German, *Algerischer Baldrian;* Flemish, *Speenkruid;* Dutch, *Speerkruid.*

[1] Bauhin, Phytopin., 1596, 293; Pin., 1623, 164; Prod., 1671, 87.

[2] Clusius, Hist., 1601, 2, 54.

[3] J. Bauhin, Hist., 1651, iii. pt. 2, 212.

[4] Ray, Hist., 1686, 394.

[5] Noisette, Man. du Jardinier, 1830.

[6] Petit, Dict. du Jard., 1826.

[7] Pirolle, L'Hort. Français, 1824–25.

[8] Burr, Field and Gard. Veg., 1863, 401.

[9] Vilmorin, Les Pl. Pot., 1883, 562; The Veg. Gard., 1885, 593.

The synonymy is as below:

Valeriana peregrina purpurea. Bauh., Phytopin., 1596, 293.

Valeriana indica. Clus., Hist., 1601, 2, 54, *cum ic.*

Valeriana peregrina purpurea albave. Bauh., Pin., 1623, 164; Prod., 1671, 87, *cum ic.*

Valeriana peregrina, seu Indica. J. Bauh., Hist., 1651, iii. pt. 2, 212, *cum ic.*

Valeriana mexicana. Ray, Hist., 1686, i. 394.

Valerianella cornucopioides, flore galeato. Tourn., Inst., 1719, 133.

Valeriana cornucopiæ. Linn., Sp., 1762, 44.

Fedia cornucopiæ. Gaertn., Fruct., 1788, ii. 37.

ALEXANDERS. *Smyrnium olusatrum* L.

The name said to be a corruption of Olusatrum (Webster's Dict.), but Ray (" Hist. Plant.," 437) says called so either because it came from the Egyptian city of that name, or it was so believed. The Italian name *macerone* is believed by Ray to have been corruptly derived from Macedonia, but a more probable origin is from *maceria*, the Italian for wall, as Columella (lib. xi. c. 3) says, " Pastinato loco semine debet conseri maxime juxta *maceriam*."

English, *Alexanders, Alisanders, Allisanders, Horse parsley, Macedonicum, Parsley macedonian.* Arabic, *Seniruion.* Belgian, *Petersilie van Alexandria, P. van Macedonien, Groot petersilie.* French, *Alexandre, Ache large, Grand ache, Maceron.* German, *Alexandrinum, Brust-wurzel, Engel-wurzel, Herba alexandriana, Gross Epfich, Peterlin, Liebstockel.* Greece, *Agrioselinon, Mauroselinon, Skuloselinon.* Greek, *Hipposelinon, Smyrnion.* Italian, *Alessandrion, Herba Alexandrina, Macerone, Smirnio.* Latin, *Hipposelinon, Olisatum, Olusatrum, Smyrnion.* Portuguese, *Cardo do coalho.* Spanish, *Apio macedonica, Perexil macedonico.*

In this Umbellifer, as De Candolle remarks, we can follow the plant from the beginning to the end of its culture. Theophrastus, who flourished about 322 B.C., speaks of it as an officinal plant, under the name of Hipposelinon. Dioscorides, who lived in the first century after Christ, speaks of the edible properties of the roots and leaves, while Columella and Pliny, authors of the same century, speak of its cultivation; Galen, in the second century, classes it among edibles, and Apicius, in the third century, gives a receipt for its preparation for the table. Charlemagne, who died A.D. 814, included this vegetable among those ordered to be planted on his estates. Ruellius's edition of Dioscorides, 1529, does not speak of its culture, nor does Leonicenus, 1529 (not necessitated by the text); but Fuchsius, 1542, says planted in gardens. Tragus, 1552, received seed from a friend, so it was apparently not generally grown in his part of Germany at this date. Matthiolus, in his "Commentaries," 1558, refers to its edible qualities. Pena and Lobel, 1570, say in England it occurs abundantly in gardens,—"in hortis copiosissimum, ubi radix illi crassior, magis succosa, vesca et tenerior, quam suapte sponte nato," and the cultivated form far better than in the wild plant. Camerarius, "Epitome," 1586, says, "in hortis seritur." Gerarde, in 1597, does not speak of its culture, but says, "groweth in most places of England," but in his edition of 1630 says, "the root hereof is also in our age served to the table raw for a sallade herbe." Dodonæus, 1616, refers to its culture in the gardens of Belgium, and Bodæus a Stapel, in his edition of "Theophrastus," 1644, says is much approved in salads, and is cultivated as a vegetable,—"Contra maceronis esui idonea, palato non ingrata; quo nomine a Gallis, Anglio, Germanis avidissime in acetariis expetitur ac ab olitoribus sedulo colitur;" yet, in 1612, "Le Jardinier Solitaire" mentions the culture of celery, but not of Alexanders, in French gardens. Quintyne, in the English edition of his "Complete Gard'ner," 1704, says "it is one of the furnitures of our winter-sallads, which must be whitened like our wild Endive or Succory." In 1726, Townsend, in his "Complete Seedsman," refers to the manner of use, but adds, "'tis but in few gardens." Mawe's "Gardener," 1778, refers to this vegetable, but it is apparently in minor use at this time; yet Varlo, in his "Husbandry," 1785, gives directions for continuous sowing of the seed in order to secure a more continuous supply. McMahon, in his "American Gardeners' Kalendar," 1806, includes this vegetable in his descriptions, but not in his general list of kitchen-garden esculents, and it is likewise enumerated by later American writers, and is included by Burr, 1863, among garden vegetables,—a survival of mention apparently not indicating use; and Vilmorin, in his "Les Plantes Potagères," 1883, gives a heading and a few lines to *maceron*, but I do not now find its seed advertised in our catalogues, and I never remember to have seen the plant or heard of its being in use in my time.

Smyrnium perfoliatum L.

This species is perhaps confounded with *S. olusatrum* in some of the references already given. Loudon says it was formerly cultivated, and McIntosh says it is thought by many superior to *S. olusatrum*,—a remark which Burr ("Field and Garden Vegetables") includes in his description. Although the species is separated by a number of the older botanists, yet Ruellius, 1529, is the only one I find who refers to its edible qualities.

This plant, which De Candolle says has been under common culture for fifteen centuries ("a été une des plus communes dans les jardins pendant environ quinze siècles," "Orig. des Pl. Cult.," 72), has shown, so far as my researches indicate, no change of type under culture. The figures which occur in so many of the herbals all show the same type of plant, irrespective of the source from which the illustration may have been taken, unless perhaps the root is drawn rather more enlarged in some cases than in others.

Alkekengi. *Physalis* sp.

The alkekengi, usually known in our seed catalogues by the name of Strawberry Tomato, is classed with the Tomatoes, and it is worthy of note that Hernandez, in his work on Mexican plants, published in 1651, did the same. There are a number of species which occur under the general name, and the plant is frequently found in gardens, as some people are fond of the fruit, whether raw or preserved. The plant most often, however, occupies waste places, springing up spontaneously after being once introduced, and its products are of very minor importance among vegetables.

Among the species that have been identified from the seeds of the "Strawberry Tomato," obtained from commercial sources, are the following:

1. *Physalis angulata* L.

This species is found widely dispersed over tropical regions, extending to the southern portion of the United States and to Japan. It is first described by Camerarius,[1] in 1588, as a plant hitherto unknown, and an excellent figure is given. It was seen in a garden by C. Bauhin[2] before 1596, and is figured in the

[1] Camerarius, Hort. Med., 1588, 70, Fig. 17.

[2] Bauhin, Phytopin., 1596, 297.

"Hortus Eystettensis,"[1] 1613. J. Bauhin[2] speaks of its presence in certain gardens in Europe. Linnæus makes a variety with entire leaves, and both his species and variety are figured by Dillenius,[3] who obtained the variety from Holland in 1732. When it first appeared in our vegetable gardens I do not find recorded.

Its synonymy seems to be as below:

Halicacabum sive Solanum Indicum. Cam., Hort., 1588, 70 *cum ic.*

Solanum vesicarium Indicum. Bauh., Phytopin., 1596, 297; Pin., 1623, 166; Ray, Hist., 1686, 681.

Halicacabum seu Solanum Indicum. Camer., Hort. Eyst., 1613, *cum ic.*

Solanum sive Halicabum Indicum. J. Bauh., 1651, iii. 609, *cum ic.*

Alkekengi Indicum majus. Tourn. Inst., 1719, 151.

Pops. Hughes, Barb., 1750, 161.

Physalis angulata L. Gray, Syn. Fl., ii. pt. i. p. 234.

2. *Physalis barbadensis* Jacq.

This species is said by Vilmorin to be sometimes cultivated in France. According to Maycock[4] it is the Pop-vine of Hughes.[5] I have not seen it growing.

3. *Physalis lanceolata* Michx.

This species was among the "Strawberry Tomatoes" grown in 1886, and occurred in two varieties,—*a*, the ordinary sort, and *b*, with broader leaves and more robust growth. Its habitat is given by Gray as from Lake Winnipeg to Florida and Texas, Colorado, Utah, and New Mexico.

4. *Physalis peruviana* L.

This South American species seems to have become fairly well distributed through cultivation. Birdwood[6] records it as cultivated widely in India, and gives native names in the various

[1] Hortus Eystet., 1613 (also 1713). Æst. ord., 13, fol. 2.
[2] Bauhin, Hist., 1651, iii. 609.
[3] Dillenius, Hort. Elth., 1774, p. 14, f. 12, t. 12; p. 12, f. 11, t. 11.
[4] Maycock, Fl. Barb., 98.
[5] Hughes, Barb., 161.
[6] Birdwood, Veg. Prod. of Bomb., 173.

dialects, and Speede[1] mentions it also. In France it is classed among garden vegetables by Vilmorin.[2] Descourtliz gives a Carib name, "*sousourou-scurou.*" Drummond,[3] who introduced the plant into Australia, after ten years reports it as completely naturalized in his region. This species differs but slightly from *P. pubescens.*[4] Gray,[5] in 1878, says it was introduced into cultivation several years ago, but has now mainly disappeared.

In English called *Cape Gooseberry*[6] or *Cherry Tomato;* in Carib, "*sousourou-scurou;* in Tagalo, "*potocan;*" in India, *Winter Cherry, Turparee;*[7] in Bengali, *Tapureea, Tapeeriya,* and *Tophlee;* in Hindustani, *Macao;* in Telinga, *Budda-busara, Pambudda.*[8]

5. *Physalis philadelphica* Lam.

Although the habitat of this species is given by Gray[9] as in fertile soil, Pennsylvania to Illinois and Texas, yet it seems to be the Miltomatl figured by Hernandez[10] in his Mexican history, published in 1651. It is described by Burr[11] under the name *Purple Ground Cherry, Purple Strawberry Tomato, Purple Winter Cherry.* The "*petite tomate du Mexique,*" as received from Vilmorin, in 1883, can be assigned to this species, as can also a "Strawberry Tomato" grown in 1885.

6. *Physalis pubescens* L.

This species has a wide range, extending from New York to Iowa, Florida, and westward, from Texas to the borders of California, and southward to tropical America. It is described by Marcgrav[12] and Piso[13] in Brazil about the middle of the seventeenth century, and Feuille,[14] 1725, mentions it as cultivated and wild in

1 Speede, Ind. Handb. of Gard., 1842, 233.
2 Vilmorin, Les Pl. Pot., 1883, 4.
3 Drummond, Hook. Jour. of Bot., 1840, ii. 347.
4 Vilmorin, Les Pl. Pot., 4.
5 Gray, Syn. Flora of N. Am., ii. pt. 1, p. 233.
6 Pickering, Ch. Hist. of Pl., 755.
7 Speede, l. c.
8 Birdwood, l. c.
9 Gray, Syn. Fl., l. c.
10 Hernandez, Nova Hist. Mex., 1651, 295.
11 Burr, Field and Gar. Veg., 1863, 593.
12 Marcgravius in Piso, Brazil, 1648, 12.
13 Piso, de Ind., 1658, 223.
14 Feuille, Obs., 1725, iii. p. 5, pl. 1.

Peru. It has been introduced into many regions. Loureiro[1] records it in Cochinchina, Bojer,[2] as cultivated in the Mauritius and in all the tropical countries, and it also occurs in the descriptions of garden vegetables in France and America. It was cultivated by Miller in England in 1739,[3] but was described by Parkinson in 1640. It had not reached the kitchen garden in 1807, but had before 1863.

Its synonymy seems as below given:

Camaru. Marcg., 1648, 12; Piso, 1658, 223.

Halicacabum sive Alkakengi Virginense. Ray, 1686, 681.

Alkekengi Virginianum, fructu luteo. Tourn., 1719, 151.

Alkekengi Virginianum, fructu luteo, vulgo Capuli. Feuille, 1725, iii. 5.

Alkekengi Barbadense nanum, Alliariæ folio. Dill. Elth., p. 10, f. 9, t. 9, 1774.

Physalis pubescens. Lin., Sp., 1762, 262.

7. *Physalis virginiana* Mill.

This species has also been grown from the seedsmen's "Strawberry Tomato." It is low spreading. Its habitat is given by Gray as Upper Canada to Florida and Texas.

The number of species which are included in the common name Strawberry Tomato is indicative of the wide source of seed-supply tributary to our seed-houses, as well as to the little importance of the plant for the vegetable garden. It is quite evident that in nature many of these species are quite variable, furnishing numerous botanical varieties. Whether any varieties have originated under culture it is scarcely worth the while to consider, as the common nomenclature is so obscuring, and as there is no indication of the plants receiving enough consideration to justify us in supposing attempts for improving through selection or careful cultivation.

American Cress. *Barbarea præcox* R. Br.

The vernacular name is a misnomer, as this species, although introduced into America, is not native, but an inhabitant of the

[1] Loureiro, Fl. Cochinch., 1790, 133. [2] Bojer, Hort. Maurit., 1837, 237.
[3] Miller's Dict., 1807.

Old World. The first mention we find is that of Ray,[1] who notices it in his description of the similar species *Barbarea vulgaris.* It is cultivated in the Mauritius,[2] in gardens of England[3] as a cress in 1855, and stated by Don,[4] in 1831, to be generally liked as a winter cress in Germany and England. In France it is included among garden vegetables by Vilmorin[5] in 1883, but not by Noisette[6] in 1829. It is recorded for American gardens by Burr[7] in 1863, and Gray,[8] in 1880, says it is cultivated from Pennsylvania southward as a winter cress.

It is known in the Southern States under the name of *Early Winter Cress,* or *Scurvy-grass,*[9] in English generally *Winter Cress, American Winter Cress,* and *Belle Isle Cress,* or *American Cress;*[10] in France[11] as *Cresson de terre, Cresson de jardin, Cresson vivace, Cresson des vignes, Cressonette de jardin, Roquette,* and *Sisymbrium;* in German, *Amerikanische Winterkresse;* in Flanders, *Wilde kers;* in Denmark, *Winter karse.*

ANGELICA. *Angelica archangelica* L.

This species is occasionally cultivated among aromatic or medicinal herbs. Its young, tender stalk in May, cut into small pieces, makes an admirable sweetmeat, and in the north of Europe the Laplanders consume its green shoots as a salad. The medicinal properties of the root were highly prized in the Middle Ages. In Pomet[12] we read that the seed is much used to make angelica comfits, as well as the root for medicine. Bryant[13] deems it the best aromatic that Europe produces.

This plant must be a native of Northern Europe, for I find no references to it in the ancient authors of Greece and Rome, nor is it mentioned by Albertus Magnus in the thirteenth century. By Fuchsius, 1542, and succeeding authors it receives proper attention, and is recorded as cultivated in gardens.

1 Ray, Hist., 1686, i. 809, sub spec., 8.
2 Bojer, Hort. Maur., 1837, 10.
3 McIntosh, Book of the Gard., 1855, ii. 170.
4 Don, Gard. Dic., 1831.
5 Vilmorin, Les Pl. Pot., 1883, 197.
6 Noisette, Man. du Jard., 1829.
7 Burr, Field and Gard. Veg., 1863, 403.
8 Gray, Field, Forest, and Gard. Bot., 1880, 54.
9 Gray, l. c. 10 Burr, l. c. 11 Vilmorin, l. c.
12 Pomet, Hist. of Drugs, 4th ed., 1748, 42.
13 Bryant, Fl. Diet., 1783, 53.

The German name *Heilige Geist Wurz* implies the estimation in which it was held, and offers clue to the origin of the word *Angelica*, or angel plant, which occurs in so many languages, as in English, Spanish, Portuguese, and Italian, becoming *Angelique* and *Archangelique* in French, and *Angelickwurz* in German. Other names, of like import, are the modern *Engelwurz* in Germany, *Engelkruid* in Flanders, and *Engelwortel* in Holland.

The various figures given by herbalists show the same type of plant, the principal differences to be noted being in the size of the root. Pena and Lobel,[1] in 1570, note a smaller variety as cultivated in England, Belgium, and France, and Gesner is quoted by Camerarius[2] as having seen roots of three pounds' weight. Bauhin,[3] 1623, says the roots vary, the Swiss-grown being thick, those of Bohemia smaller and blacker.

ANISE. *Pimpinella Anisum* L.

Anison was known to the ancient Greeks, and Dioscorides says the best came from Crete, the next best from Egypt; and it is mentioned by Theophrastus.[4] Pliny,[5] in the first century, says "*anesum*, green or dry, is desirable in all seasonings or sauces," and the seeds are even sprinkled in the under crust of bread, and used for flavoring wine. He quotes Pythagoras as praising it whether raw or cooked. Palladius,[6] in the beginning of the third century, gives directions for its sowing. Charlemagne,[7] in the ninth century (A.D. 812), commanded that anise should be sown on the imperial farms in Germany. It is mentioned also by Albertus Magnus[8] in the thirteenth century. It seems to have been grown in England as a pot-herb prior to 1542, as Boorde,[9] in his "Dyetary of Helth," printed in that year, says of it and fennel, "These herbes be seldom used, but theyr seedes be greatly occupyde." Ruellius[10] records it in France in 1536, and gives the

[1] Pena and Lobel, Adversaria, 1570, 311.
[2] Camerarius, Hort., 1588, 16.
[3] Bauhin, Pin., 1623, 155.
[4] Bodæus a Stapel, Theop., 1644, 744.
[5] Pliny, lib. xx. c. 72.
[6] Palladius, lib. iii. c. 24; lib. iv. c. 9.
[7] Quoted in Pharmacographia, p. 310.
[8] Albertus Magnus, De Veg., Jessen ed., 1867, 476.
[9] Quoted in Pharmacographia, 311.
[10] Ruellius, De Stirp., 1536, 701.

common name as *Roman fennel*, the same as Albertus Magnus used in the thirteenth century. It is classed among culinary herbs by Laurembergius[1] in 1632, and in America by McMahon[2] in 1806.

In the seventeenth century Quintyne[3] records the use of the leaves in salads. The seeds now serve to flavor various liqueurs; in Italy they appear in diverse pastries; in Germany they are put into bread; in England, in special bread, in rye bread, and even in cheese.[4] In Malta, localities in Spain, France, Southern Italy, Germany, and Russia the plant is grown on a large scale for the seed, which enters commerce for use in flavoring medicines, etc. It is also grown in Northern India and Chili.

The plant is indigenous to Asia Minor, the Greek islands, and Egypt, but is nowhere to be met with undoubtedly growing wild; and I have found no indication of its having formed varieties under cultivation, except that Bauhin records one sort having rounder and smaller seeds than the common.

(To be continued.)

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

In all of our four hundred colleges and universities, with a dozen conspicuous exceptions, the instruction in the biological sciences is but little more than a farce. College presidents and trustees seem to think that while some special knowledge is necessary for teaching the classics and mathematics, any one is competent to give instruction in botany and zoology. Indeed, it would even appear that they regard eminence as an investigator in either of these branches as an undesirable feature in an instructor. The teachers of biology are mostly men without biological training, men whose ideas and methods are those of a generation ago, and who have no more idea of modern science and modern scientific thought than have the poorest of the pupils who are unfortunate enough to come under them. Their whole idea of botany is "analysis," while zoology is but

[1] Laurembergius, Hort., 1632, 193.
[2] McMahon, Am. Gard. Kal., 1806.
[3] Quintyne, Complete Gard., 1693.
[4] Joigneaux, Traité des Graines, 146.

cut-and-dried classification. This is true not only of most Western institutions, but of many in the East as well. It was in one of the latter that the students of zoology were treated to three solid months of worms, while, for aught the professor said, they were left in absolute ignorance of the existence of the groups of protozoa and vertebrates. Too frequently ministers and lawyers are installed as professors of natural history. Neither have had the training necessary to fit them for the position, but they are graduates of the college, and must be taken care of. Those in authority do not seem to realize that the professional studies of a clergyman, instead of fitting one for a student of nature, are a positive hindrance. The whole theological training lies in the lines of faith and reverence for authority, while science demands of its devotees, if not a sceptical spirit, one of complete independence. One cannot rely upon any statement solely on the grounds that it is advanced by a Cuvier or an Agassiz. Science has no infallible gospel wherewith to settle all disputes except that presented by the book of nature, and how difficult this is of interpretation only the original investigator knows. The lawyer or the clergyman, when he enters the field of science, brings his traditions and his old methods of thought with him. He looks for the written accounts as he formerly turned to his Bible or his " Blackstone," and when he finds any statement in print, he pins his faith to it as unquestionably as he did to the other authorities in the days of yore.

Were this selection of incompetent instructors a matter of necessity it would not speak well for American science; but it is not. We have in our country an abundance of able students, but, strange to say, it is the exception, rather than the rule, to find our best workers occupying professors' chairs. This results not from any disinclination for teaching on the part of these students, but from the stupidity of our college officers, who, if offered the choice between excellence and mediocrity, almost invariably choose the latter.

When the Society of American Naturalists was formed, one of the objects proposed was a reform in this respect; but so far nothing has been accomplished in this direction. How to proceed in changing this state of affairs may be a question, but it is to be hoped that in the early future some steps may be taken which will tend to improve the character of instructors and instruction. A list of eligible persons, with accounts of their work, etc., might be prepared and placed in the hands of a committee, so that those in search of a professor might know from whom to select, while a few protests sent to college trustees, on making an eminently unfit nomination, might bear some good fruit.

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

America. ALASKA.—On his way to Mount St. Elias, Lieutenant Schwatka crossed an unknown river, which, at eight miles from its mouth, is said to be a mile in width, and to flow at a rate of ten miles an hour. It was named Jones River. A glacier twenty miles wide was seen by the explorers. It extended fifty miles along the base of the St. Elias Alps, and was named the Agassiz Glacier. Another to the west was called the Guyot Glacier, while a third was named in honor of Professor Tyndall. They then ascended Mount St. Elias to a height of seven thousand two hundred feet above the snow-line. Glaciers were seen rising, sometimes perpendicularly, to heights varying from three hundred to three thousand feet, and enormous crevasses were frequent. Three peaks, varying from eight thousand to twelve thousand feet, were seen, and named Cleveland, Whitney, and Nicholls.

THE SOURCE OF THE MISSISSIPPI.—The controversy concerning Lake Glazier has been a long one. *Science* (August 13) prints a letter by Russell Hinman, giving copies of Schoolcraft's map, and those of Nicollet, 1843; the Land Office, 1879; and Glazier, 1881. He also gives, in parallel columns, the language used by Schoolcraft (1832) and that of Glazier (1881). Nicollet's map shows three small lakes in the position of Glazier's single one. The similarity of the words has, of course, no weight as evidence concerning a geographical fact, though it may be explained by facts occurring in similar order. Pearce Giles (*Science*, September 24) endeavors to prove that the lakelets or ponds on Nicollet's map have nothing to do with the source of the river, and that those surveyed, mapped, and named by the Land Office were mere lakelets, and not identical with Lake Glazier.

Captain Glazier's claim to discovery seems, however, to be completely disposed of by the letter of H. D. Harrower in *Science* (October 8). Mr. Harrower gives a map reduced from *fac-simile*

[1] Edited by W. N. LOCKINGTON, Philadelphia.

tracings of maps of the surveys made in October, 1878. This shows "Elk Lake" in exactly the position of Lake Glazier. Into it runs a small stream, and another stream, of about equal length, flows into the western arm of Lake Itasca. The last stream heads in a tiny lakelet. Neither stream much exceeds two miles in length. Elk Lake has, of course, precedence of "Lake Glazier."

The great Lake Mistassini, regarding which exaggerated reports were afloat some time ago, has been proved to be an expansion of Rupert River, about one hundred miles in length and twelve in breadth. Depths of three hundred and seventy-four and two hundred and seventy-nine feet have been found. Above this is Little Mistassini, a widening of the river to a width of six miles.

Europe. MORESNET.—*Science*, in its Paris letter, reports a bit of political geography not generally known. It is that there is between Belgium and Germany a small and quite independent state that is smaller than Monaco, San Marino, or Anderra,—that of Moresnet. The delegates who fixed the frontier between Belgium and Germany in 1815 disagreed at this point, each wanting the mineral riches of the little spot of six square kilometres. Finally they left it independent. It had then about fifty huts, but now it is a flourishing town of more than eight hundred houses.

THE CAUCASUS is now within reach of English summer tourists, and Messrs. Dent and Donkin spent the summer of 1886 in exploring the peaks and glaciers encircling Kashtantall (17,096 feet). They ascended Tau Tetmuld (16,500 feet), and made other glacier expeditions, which will necessitate corrections in the maps of the district.

Asia and the Islands. AUSTRALIA.—The Kimberley gold-fields of Western Australia lie in a fertile tract of country between King Sound and Cambridge Gulf in the tropical portion of the colony. The new town and port of Derby, on King Sound, has arisen in connection with these diggings. The entrance to the Sound, by Sunday Strait, is remarkable for the fierceness of the tide. Cambridge Gulf, at the head of which the new settlement of Wyndham is situated, is pronounced by Mr. Forrest to be one of the finest harbors of Australia, is protected from all weathers, has numerous bays, and good deep water. The "proclaimed" gold-field is two hundred and twenty miles from Wyndham by the nearest route. The gold is found in good-sized lumps, on or near the surface, near the head-waters of the Ord River, which flows into Cambridge Gulf.

FORMOSA.—The third and last of Mr. Taylor's papers on the aborigines of Formosa describes the Diaramocks, who are supposed to be the true aboriginal inhabitants, without admixture with Chinese. Little is known of them, as they hold aloof from other tribes. They inhabit the mountain ranges to the northwest of the Tipuns, and are a fierce and intractable race, addicted to cannibalism. There is also said to be a tribe of red-haired savages living among the central mountains. The Pepo-huans seem to be the result of marriages between aboriginal women and whites and Chinese. The inhabitants of Formosa are intelligent, and the Chinese have a proverb to the effect that when the savages take to wearing trousers there is no room for a Chinaman.

BORNEO.—Mr. Pryer states that the natives of North Borneo are of mixed aboriginal and Chinese ancestry. On the east coast there is little of the native type left. This race, the Dusuns, is settling down under the North Borneo Company, and is thriving and increasing. In the long course of Chinese trade with the island, a slow and steady infiltration of Chinese blood took place.

Africa. THE LAST GERMAN CONGO EXPEDITION.—The last German Congo Expedition, 1884–86, made extensive land journeys. Dr. Buttner proceeded from San Salvador, the residence of the king of the Ba-Congo, to the Quango, passing through the country of the Sombo into that of the Mayakke. The Sombo are great ivory-traders. At the capital of the Muene Putu Kasonga (Kiamoo), which has about one thousand houses in its stockade, our traveller was compelled to turn northwards. Passing the Kingunshi rapids of the Kuango, he crossed the country of the Warumba. At Ngatuka a Queen Geu (Goy) is in power, and her brother rules over the Bansinik at a town which has an audience-hall that will hold one thousand people. Thence he proceeded to the Congo, which he reached above Leopoldville.

Lieutenant Kund found his way to Kiamoo, and then penetrated eastward by crossing the Quango lower down. Through the country of the hostile Bokange, he reached the Sankuru at the part inhabited by the Pambala, who were friendly. After crossing the Sankuru in boats, which were built for the purpose, the country of the Basengo or Zenge was entered. This is a primeval forest, while to the west of the river all is savanna. The villages are in clearings of the forest. All attempts to establish friendly relations with the Basengo were vain. After thirty days' journey through this forest, the westward flowing Ikatta, Lukatta or Lukenye, was found. (Lieutenant Wissman believes Dr. Wolff's Lomanie to be this river.) Farther eastward pacific relations were established with King Gakoko, ruler of the Basengo and of their smaller neighbors, the Bikalli. With the Bikalli, and with the Bavumbo beyond them, several contests occurred, resulting in the former case in the loss of two men killed and seven wounded, and in the latter in the wounding of Lieutenant Kund himself, who was struck with three arrows, which his companion (Lieutenant Tappenbeck) cut out with a razor. The land journey was then abandoned, and the river descended in boats to the Congo. The German accounts of this expedition call attention to the fact that in many of the names of tribes, etc., those mentioned by the Portuguese missionaries may be recognized; also to the similarity between the names of tribes in this region and those of others dwelling on the Cunene or Zambezi (*i.e.*, Adima, Pende, Bayeye, Balula, Basaka, Bangola). This points either to similarity of language, or to an extensive migration of tribes.

African Notes.—Mr. H. H. Johnston made a journey up the Cameroons River in June last. A few miles beyond the village of Ngale Nyamsi, he obtained, from a height of five hundred feet above the river, a view of a chain of fantastically peaked mountains lying fifty to sixty miles from the river and probably ten thousand feet or more in height.

M. J. de Brazza, brother of the governor of the French Congo, reached the Sekoli (the Punga of Grenfell) by an overland journey from the Ogowé through a fertile and well-populated region, the abode of the Mbete and Ossete tribes. On the Sekoli dwell the Ikata, a commercial but warlike people. The river was descended in canoes to where it receives the Amboli and assumes larger proportions.

The French gunboat "Niger" made a voyage in the autumn of 1885 from Kulikoro to Jenne, on the Upper Niger. This part was only known from the accounts of Mungo Park and René Caillé. The once populous town of Sansandig, a considerable commercial centre in Park's time, is now a heap of ruins, having fallen a prey to the Tukaleurs. M. Davoust placed all the tribes on the left bank under French protectorate. Those on the right are ruled by Ahmadu, the Tukaleur chief.

The Rev. G. Grenfell lately read before the Royal Geographical Society of London an account of his recent explorations in the steamer "Peace." He mentions the discovery by Dr. Wolff of a river known as the Lomami which falls into the Sunkuru from the northeast, but does not believe it identical with the river of that name which flows into the Congo just below Stanley Falls, which he himself ascended as far as 1° 33′ S. lat. in January, 1885; and which at that point was a stream of thirty-five thousand feet per second, at an altitude of thirteen hundred and fifty feet above the sea.

GEOLOGY AND PALÆONTOLOGY.

Hyatt on Primitive Forms of Cephalopods.[1]—The succession of forms in any genetic series of Nautiloids is from a straight shell through a curved cyrtoceran form to a loose-coiled gyroce-

[1] Abstract of a paper read before the National Academy of Science, Boston meeting, by Alpheus Hyatt.

ran, and finally to a close-coiled nautilian shell. Among Ammonoids the same series occurs only on one occasion, at the beginning of the group, during Silurian and Devonian time, in a series which may be said to include Bactrites, a straight orthoceratitic shell, Mimoceras, a true gyroceran form, and Anarcestes, which is close-coiled. The discovery of a proto-conch upon the apex of Bactrites by Beyrich and Branco leaves no doubt that it is, as heretofore supposed by the writer, a transitional form from Orthoceras to Ammonoidea. These forms are primitive or transitional radicals and have cylindrical whorls, except in Anarcestes. In this genus a depressed semilunar whorl is for the first time introduced. This form of whorl is not at once and generally adopted in the young. On the contrary, these are usually tubular and often straight like Bactrites, or loosely coiled like the adults of Mimoceras. Others, again, after passing through a stage with tubular whorls, may become suddenly close-coiled and have at once a depressed form of whorl. Such fluctuations in embryonic characters are common even in different varieties of the same species until we reach the Trias. In this formation, or possibly earlier in the Dyas, the larvæ are all close-coiled, and the whorls at an early stage invariably have the depressed semilunar form like the adults of Anarcestes. Throughout the Trias also there occur in great abundance smooth shells, Arcestes, in which the full-grown adults are smooth and have the similar anarcestian peculiarities. Thus from the Silurian to the Trias, inclusive, the semilunar or depressed smooth whorled forms are continuous. These make up a central trunk of stock forms, which we have designated as primary radicals, confining the use of the words primitive radicals to the transitional genera Bactrites, Mimoceras, and the like.

Compressed forms differing but slightly from the depressed species occur in Anarcestes and in Arcestes, etc. In the Trias and Lias these compressed, smooth shells which we have called secondary radicals become much more important. In Psiloceras planorbe we strike upon a species of this character to which we can trace all the Arietidæ of the lower Lias and many forms of higher Jura and Cretaceous.

The great trunk of radical species has, of course, many lateral branches, which strike off from it during the course of its chronological migrations through the Palæozoic and Trias, but of these we have taken no account, because they were purely lateral offshoots which did not arise from fission or the modification of the main stock of radical generators. In the Jura, however, this main stock itself splits into branches, and the primary and secondary radical forms are replaced by more complicated radicals.

There is a side branch, which arose in the early Trias, and in which they are still, in a measure, preserved and continued, but the main trunk line is replaced by irregular branches beginning with species which we have styled tertiary radicals. These have either the depressed or compressed form of whorl, are discoidal, and, therefore, resemble the primary and secondary radical throughout life. But, on the other hand, they are often highly ornamented with spines and ribs, and have more complicated sutures.

The tertiary radicals give rise to series of species, which may become excessively involute and otherwise modified in the higher forms, but these are never the radical generators of new forms or new series. There are, therefore, no quaternary radicals to continue the direct lines of descent from the Trias, so far as progressive forms are concerned.

But when we turn our attention to retrogressive forms, the story is different. Series of degraded or distorted forms occur in the Jura and Cretaceous, and several families afford good examples. In these series we can usually trace an origin in some close-coiled, discoidal, ornamented shell, which belongs to the tertiary radicals, or is not far removed from them in its aspect.

We have frequently pointed out the nature of these degradations. They are similar to the senile degenerations observed in the individuals of the tertiary radicals and other species of the progressive series of the Ammonoids. These geratologous transformations, whether occurring in the senile degenerations of a shell or in a series of species, tend to produce similar results, namely, the decrease in size and uncoiling of the whorl, destruction of ribs and spines, reduction of sutures to more primitive proportions. The final result, as we have often said, is a straight almost smooth shell, Baculites. We now wish to assert that Baculites is a polyphyletic group derived from many tertiary radicals, and separable into a considerable number of distinct genetic groups.—*Alpheus Hyatt.*

New Jersey Cretaceous.—The different beds of the New Jersey Cretaceous consist of layers of sedimentation, almost always conformable, which have been distinguished by the State Geological Survey as Plastic Clays, Camden Clays, Lower Marls, Middle Marls, Upper Marls, with which series in this paper the Eocene Marls have been united. Beds of sand separate these beds, and the fossils are limited to the green marls and clays. The clay-beds in their lower part have yielded five species of fossils, shells which are entirely estuarine in character, the genera recognized being Astarte, Corbicula, Gnathodon, and a new genius, Ambonicardia. This last genus resembles the Jurassic forms of Europe.

At the upper limit of the clay-beds in the clay marls are found iron-stone nodules containing casts of fossils identical with Lower Marl fossils, or with those from the Clay Marls at Crosswicks and Haddonfield. Their position may be in the Lower Marl-beds or in the clays proper. More study and investigation is necessary to determine this point. Lower down in the clay fossil plants occur cretaceous in character (Newberry).

The Lower Green Marls hold most of the cretaceous fossils, and this fact, together with a showing of the comparative richness in fossils of the entire series discussed, is made evident by the following tables:

Summary of Lamellibranchiata.

Formations.	Families.	Genera.	Species.
Plastic Clays	4	4	5
Camden Clays	1	2	12
Lower Marls	27	76	155
Middle Marls	8	9	11
Base of Upper Marls	12	13	16
Eocene Upper Marls	12	17	23
Total	31	89	222

Summary of Gastropods.

Formations.	Families.	Genera.	Species.
Plastic Clays	...	...	1 ?
Camden Clays	...	...	.. ..
Lower Marls	25	60	125
Middle Marls	5	6	7
Base of Upper Marls	7	8	8
Eocene Upper Marls	21	29	52
Total	31	80	190

Summary of Cephalopods.

	Species.
Lower Marls	11
Middle Marls	1
Eocene Marls	2

General Summary of Species.

	Cretaceous.	Eocene.
Brachiopods	5	2
Lamellibranchiata	199	23
Gastropoda	138	52
Cephalopoda	12	2
Total	354	79

The fossils are usually restricted to single beds, at most only four molluscan forms, passing from one bed to another. The zoological break is conspicuous, but is accompanied by no geological unconformity, a slight exception to this being seen only at the junction of the Eocene Marl-beds and the layers immediately below it. The brachiopods, so common a feature in the Cretaceous of Europe, are proverbially rare in American strata of this age, only five species being recognized, all Terebratulidæ.

Of the brachiopods, *Terebratula harlani* and *T. lachryma* occur in South Carolina, and *T. floridana* in Alabama.

Of Lamellibranchiates of the Lower Marl-beds of New Jersey,—

41	species are known	from	Alabama.
21	"	"	Tennessee.
21	"	"	Mississippi.
6	"	"	Texas.
20	"	"	North Carolina.
4	"	"	Dakota.
3	"	"	Europe.

Of the Middle Marl-bed species,—

Alabama	has	3	species.
Tennessee	"	1	"
Texas	"	1	"
Dakota	"	1	"

Of the Eocene species, *Crassatella alta* is the only species known from any other State.

Of the Gastropods, which have been less studied in the Southern States,—

North Carolina	has	1	species.
Tennessee	"	2	"
Alabama	"	12	"
Mississippi	"	7	"
Texas	"	1	"

Of the Cephalopods, most have been recognized in Alabama and Texas. Of the Eocene Gastropods, ten occur in Alabama.

Of the two hundred and twenty-two species of Lamellibranchiates, seventy-four of them are new species; and of one hundred and ninety species of Gastropods, one hundred and seven are new. Comparison permits the conclusion arrived at before by others on less extensive determinations, that the New Jersey Cretaceous Marls are the equivalent of No. 4 or of Nos. 4 and 5 of the Upper Missouri Section.

The work done on the Cretaceous is yet fragmentary, as many specimens are too imperfect for use, and the middle and base of the upper marls have not been systematically examined.—*R. P. Whitfield.*

Geological News. GENERAL.—A catalogue of the Blastoidea in the Geological Department of the British Museum of Natural History is the joint work of Mr. R. Etheridge and Mr. P. H. Carpenter. The Blastoids are given a position as a group equivalent in rank to the brachiate Crinoids. The term Pelmatozoa, or palmed animals, includes the crinoids and cystids, and the class Blastoidea have the following peculiar characters among others: A subambulacral lancet-plate which is pierced by a canal that lodged the water-vessel, the absence of under-basal plates, the constant presence of five interradials, the constant but peculiar trimerous symmetry of the base, a character previously observed only in one cystid and possibly in one crinoid, and the very symmetrical grouping of the hydrospires, which are limited to the radial and interradial plates, and have their slits parallel to the ambulacra. The Blastoids are the most regular of Echinoderms. All have thirteen plates except Pleacrinus, in which one is divided.

Silurian.—E. O. Ulrich has published descriptions of new Silurian and Devonian fossils, chiefly Polyzoa, and describes as new genera Busiopora and Lichenotrypa.

Palæozoic.—Rohon and Zittel have recently studied the histological structure of the conodonts. As a result, they declare that they differ entirely from true teeth or the so-called teeth of lampreys and of Mollusca, and do not resemble any part of the hard parts of Crustacea, but they agree closely with the teeth of Annelid and Gephyrean worms.

Tertiary.—The second number of the Annals of the New Natural History Museum at Vienna contains an important paper upon the Miocene pteropods of Austro-Hungary, by Ernst Kittl. Illustrations of most of the species are given, and ten new species described.

Pliocene.—The flora of the Cromer Forest-bed (England) has been investigated by Mr. Clement Reid, who found in various samples of dark peaty sandy clays, the seeds or fruits of forty species of dicotyledons, eighteen of monocotyledons, five of gymnosperms, and three cryptograms, besides some mosses and Characeæ. With a few exceptions, the same plants still exist in the locality.

Quaternary.—Professor Lindström believes, from the configuration and structure of the rock-terraces in Gottland, Sweden, that the island received its present form by denudation, previous to the Glacial period, and that various changes of level have taken place since that time. Raised beaches are traced in Gottland at various elevations up to two hundred and fifty-nine feet above sea-level, the highest point on the island. Erratic bowlders are traced from the Aland Isles, possibly from the southwest of Finland, and from the bed of the Baltic.

Dr. Nathorst gives his adhesion to the belief that pebbles with distinctly faceted surfaces are due to the action of wind-driven sand. Mr. Travers, in 1869, first called attention to such pebbles, and thus explained their origin. Similar pebbles have been discovered in the Eophyton sandstone at Lugnas, Sweden.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—Mr. G. A. J. Cole[2] has recently attempted to explain the occurrence in rocks of "hollow spherulites" like the lithophysen of Von Richthofen. The principal theories proposed to account for these bodies are discussed, and that one is accepted which regards them as the result of the alteration of spherulites, in preference to the one in which a vesicular origin is assigned them. The present writer thinks that a study of the phenomena attending the alteration of spherulites will explain satisfactorily the occurrence of the hollow spherulites. In many of these there is often found a little patch of felsitic material with a radial structure, and from this Mr. Cole argues that the whole body was once of the same nature, and that the greater part of the original filling has been removed by decomposing agents, probably through the channels afforded by perlitic cracks. He then examines[3] many of the spherulitic rocks of Great Britain and some from localities in Europe and America, and finds that his views are on the whole confirmed.——Professor Milne, in a recent number of the Transactions of the Seismological Society of Japan,[4] states that the lavas of the Japanese volcanoes (one hundred in all, of which forty-eight are still active) are chiefly andesites, the hornblende varieties of which frequently contain quartz. Those containing olivine approximate to basalts, though true basalt is rare. A critical study of these rocks is now being made by members of the Japanese Survey.——A microscopical examination[5] of the volcanic ash ejected during the recent eruption in New Zealand shows it to contain fragments of limpid plagioclase crystals, dark green pleochroic hornblende, sometimes fibrous, and extinguishing at 15°, biotite and a "golden-colored mica" in well-formed crystals of hexagonal outline, pyrite, magnetite, broken pieces of sulphur, and glass containing crystallites arranged in flow-lines.——By treatment of the granite-porphyry from Beucha with hydrofluoric acid, and then the residue thus obtained successively with various other acids, Kroustshoff[6] has succeeded in isolating from it small colorless isotropic crystals with glassy inclusions. These crystals possess a specific gravity greater than 3, a refractive index equal to that of garnet or spinel, and show, before the spectroscope, the lines of iron, calcium, magnesium, and aluminium. The author calls attention to the similarity between these crystals and those which he obtained in a like manner from the phonolite[7] of Olbrück, and

[1] Edited by Dr. W. S. Bayley, Madison, Wisconsin.

[2] Quart. Jour. Geol. Soc., xli., No. 162, May, 1885, p. 162.

[3] Ib., xlii., No. 166, May, 1886, p. 183.

[4] Vol. x. part 2, Abst. Nature, Nov. 4, 1886, p. 19.

[5] J. Joly, Nature, Oct. 21, 1886, p. 595.

[6] Note sur un nouveau minéral accessoire de la roche de Beucha (près de Leipzig). Bull. de la Soc. Franç. de Minéralogie, ix., No. 4, 1886; also Neues Jahrb. für Min., etc., 1886, ii. p. 180.

[7] Ib., ix., No. 3.

which he believes are members of the spinel group. A mineral very like those above mentioned also occurs in the tonalite from Adamello. The same author, in another paper, describes a peridotite[1] from Goose Bay, in the Straits of Magellan. It consists essentially of olivine and enstatite, with picotite and apatite as accessory minerals, and serpentine, chrysolite, bastite, and magnetite as secondary constituents. The olivine contains gas, liquid and glass inclusions. The fibres of the bastite seem to have been curved by some mechanical agency (pressure). An analysis of a comparatively fresh specimen yielded,—

SiO_2	Al_2O_3	Fe_2O_3	Cr_2O_3	Fe(Mn)O	MgO	CaO	H_2O
43.39	2.26	0.35	0.28	10.47	39.89	2.33	1.54

——Basalts, pyroxene-andesites, hornblende-pyroxene-andesites, hornblende-mica-andesites, and dacites, very like similar rocks occurring in the western portion of our own country, are described by Messrs. Hague and Iddings[2] from the Republic of Salvador, Central America.——Certain "Pliocene sandstones" from Montana and Idaho, according to Mr. G. P. Merrill,[3] consist of pumiceous dust cemented by calcite or clayey material. An analysis of one of these from Little Sage Creek, Montana, yielded Mr. Whitfield,—

SiO_2	$Fe_2O_3 + Al_2O_3$	CaO	MgO	Na_2O	K_2O	H_2O	loss by ignition
65.56	18.24	2.58	0.72	2.08	3.94	1.12	6.50

Mineralogical News.—The lithia micas of Maine and the iron-lithia micas of Cape Ann, Mass., have been subjected to a very thorough chemical examination by Mr. F. W. Clarke and the gentlemen associated with him in the chemical department of the U. S. Geological Survey. The various types of these minerals, from different localities in the States named, have been analyzed, and the results of these analyses are given in a paper in the *American Journal of Science.*[4] By supposing fluorine to replace the hydroxyl (HO) group in ortho-silicic acid, a series of fluo-silicic acids may be obtained as a nucleus upon which to build the formulæ representing the composition of the various lithia micas. For example, if we represent muscovite by

$$Al \begin{cases} SiO_4 \equiv R_3 \\ SiO_4 = Al \\ SiO_4 = Al \end{cases}$$

then lepidolite might be represented by

$$Al \begin{cases} SiFO_3 = R_2 \\ SiO_3 \diagdown \\ SiFO_3 \diagup\!\!\diagup \end{cases} \!\!\! > Al,$$

and cryophyllite by

$$\begin{matrix} Al \begin{cases} SiFO_3 = R_2 \\ SiO_3 - R \\ SiO_3 \end{cases} \\ Al \begin{cases} \diagup \\ SiO_3 - R \\ SiFO_3 = R_2 \end{cases} \end{matrix}$$

[1] Note sur un nouveau minéral accessoire de la roche de Beucha (près de Leipzig). Bull. de la Soc. Franç. de Minéralogie, ix., No. 1; also Neues. Jahrb. für Min., etc., 1886, ii. p. 180.

[2] Amer. Jour. Sci., xxxii., July, 1886, p. 26.

[3] Ib., Sept. 1886, p. 199.

[4] November, 1886, p. 353.

——Messrs. Penfield and Harper[1] have carefully analyzed pure *ralstonite* from Greenland, and have found it to contain,—

Mg	Na	K	Ca	Al	F	H_2O	total
4.46	4.27	0.12	0.03	24.25	39.96	18.73	91.70

Upon calculation it was found that the amount of fluorine obtained in the analysis was not sufficient to unite with all the metals; hence these authors assume that the metals which are in excess of the fluorine combine with hydroxyl. If this be true, the composition of ralstonite as calculated from the analysis is as follows:

Mg	Na	K	Ca	Al	F	OH	OH_2
4.39	4.27	0.12	0.03	24.25	39.91	16.27	10.12 = 99.36,

and the mineral may be regarded as an isomorphous mixture of $(MgNa_2)Al_3F_{11}.2H_2O$ and $(MgNa_2)Al_3\ (OH)_{11}$.——The mineral which best illustrates the power of fluorine to replace hydroxyl in a chemical compound is *herderite*, which has recently been shown[2] by these same investigators to consist of an isomorphous mixture of $CaBeFPo_4$ and $CaBe(OH)Po_4$.——*Lucasite*, a new variety of vermiculite, from Corundum Hill, Macon County, N. C., is described by Mr. T. F. Chatard[3] as a foliated mineral of a yellow-brown color, with eminent basal cleavage and a submetallic, greasy lustre. It dissolves in hydrochloric acid and exfoliates when heated, swelling at the same time to twice its original volume. It is biaxial and negative, with a small optical angle.——The well-known garnet pseudomorphs from the Lake Superior region have been examined by Messrs. Penfield and Sperry.[4] According to these gentlemen the alteration of the garnet consists in a slight oxidation of its iron, a decrease of its silica, an almost total disappearance of its manganese and calcium, and an increase in its magnesium, alkalies, and water. The resulting mineral is a ferrous chlorite[5] with a composition approaching that of prochlorite. An examination of a decomposed garnet from Salida, Colorado, yielded the same result.——Some very fine pseudomorphs of limonite after pyrite are figured by T. G. Meem[6] in the October number of the *American Journal of Science*, in which the striations due to the oscillation of the octahedron and icositetrahedron are well preserved.

Meteorites.—During the past summer quite a number of short articles descriptive of meteorites have appeared in the *American Journal of Science*. In the June number Mr. W. E. Hidden[7] describes two masses, neither of which was seen to fall. One is a meteoric iron, found in Independence County, Ark. It weighs ninety-four pounds. A curious feature in connection with it

[1] Amer. Jour. Sci., Nov. 1886, p. 380.
[2] Penfield and Harper, Amer. Jour. Sci., xxxii., Aug. 1886, p. 107.
[3] Amer. Jour. Sci., xxxii., Nov. 1886, p. 375. [4] Ib., Oct. 1886, p. 307.
[5] *Cf.* American Naturalist, Feb. 1886, p. 161.
[6] Amer. Jour. Sci., xxxii., p. 274. [7] Ib., xxxi., No. 186, p. 460.

is the existence through it of a hole measuring five-eighths of an inch in diameter at its narrowest part. Its composition is Fe = 91.22; P = 0.16; Co and Ni = 8.62; thus belonging to the class holosiderite of Brezina. The second mass is from Laurens County, S. C. Its composition, as determined by Mr. J. B. Mackintosh, is as follows: Fe = 85.33; Ni = 13.34; Co = 0.87; P = 0.16. The Widmanstättian lines indicate a regular crystallization. The presence of occluded hydrogen and little masses of ferrous chloride (lawrenceite) in its mass render this meteorite exceedingly interesting. In the October number the same author[1] describes a meteor found at Fort Duncan, Maverick County, Texas. It weighs ninety-seven and a quarter pounds, and contains 94.90 per cent. Fe; P = 0.23; Ni and Co = 4.87. Sp. gr. = 7.522. Its peculiarity is the development in it of two series of very fine lines crossing each other at an angle of 70°.——Since the publication of the article[2] on the three masses of meteoric iron from Glorieta Mountain, New Mexico, four other pieces of the same meteorite have been found. An analysis by Mr. Eakins, of the United States Geological Survey, of what is supposed by Mr. Kunz[3] to be the seventh piece of this meteorite, yielded,—

Fe	Ni	Co	Cu	Zn	Cr & Mn	C	P	S	Si
88.76	9.86	0.51	0.03	0.03	traces	0.41	0.18	0.01	0.04

——The crystalline structure of meteoric irons has been well worked out by O. W. Huntington,[4] who examined the collection of these bodies belonging to Harvard College. By a very careful investigation of the appearance of the Widmanstättian figures on cleavage faces of the different specimens, and by comparison of similar appearances in the case of many minerals, which, during their crystallization, extruded various impurities (as, for instance, many micas containing magnetite), Mr. Huntington is led to conclude that (I.) many meteoric irons show cleavages parallel to the principal planes of symmetry in the isometric system; (II.) that the Widmanstättian figures and Neumann lines are sections of planes of crystalline growth parallel to the three planes mentioned; and (III.) that the features of the Widmanstättian figures are due to the elimination of incompatible material during the process of crystallization. The results of the investigation strengthen the belief that meteoric irons were thrown off from the sun or one of the fixed stars, and that they have cooled very slowly, while revolving in a zone of intense heat.——A meteoric stone found in Utah, between Salt Lake City and Echo, according to Messrs. E. S. Dana and S. L. Penfield,[5] appears under the microscope to consist of spherules of olivine, some of which have a distinct coarsely fibrous structure in consequence of the inclu-

[1] Amer. Jour. Sci., Oct. 1886, p. 304.
[2] G. F. Kunz, ib., III. xxx. p. 235; *cf.* American Naturalist, Dec. 1885, p. 1214.
[3] Ib., xxxii., Oct. 1886, p. 311. [4] Ib., III., xxxii., Oct. 1886, p. 284.
[5] Amer. Jour. Sci., xxxii., Sept. 1886, p. 226.

sion of dark-colored glass, bronzite in broken fragments and also in spherules with a fine fibrous structure, broken plagioclase, rich in black inclusions lying parallel to the twining planes, and, finally, patches of an isotropic mineral, probably maskelynite. It contains the following constituents: nickeliferous iron, 17.16 per cent.; mineral portion, 82.84 per cent. The iron yielded upon analysis, Fe = 91.32 per cent.; Ni = 8.04; Co = 0.60; Cu = 0.04. The mineral portion was divided into two parts, one soluble in hydrochloric acid yielded, FeS = 6.08; NiS = 0.62; and 48.85 per cent. silicates; the other, insoluble in this acid, gave, chromite 0.75, and 43.22 per cent. silicates. A second meteorite, from Cape Girardeau, Missouri, proved, upon examination, to belong to the same general class as the one last mentioned.——A catalogue of the meteoric stones in the collection of Yale College, one hundred and forty-seven in number, is published as an appendix in the same number of this journal. ——Perhaps the most important paper on meteorites which has appeared during the year is that of Reusch.[1] In this are described four Scandinavian meteorites, each of which presents interesting features. The most noteworthy of these is the occurrence of olivine in forms imitative of organic structures, and also, together with bronzite, forming spherulitic bodies in a ground-mass composed of crystals of bronzite, augite, and iron in a glassy base. The most instructive fact in this connection is the discovery of a brecciated structure in two of the meteors described. The rounder grains which occur in the crystalline ground-mass surrounding them are of the same nature as this ground-mass, and are in turn composed of other smaller grains of similar mineralogical composition. A gradual transition from the large fragmental particles to the "chondra" was traced, and from this fact, in connection with the others above mentioned, the author draws certain general conclusions in regard to the origin of meteoric bodies, which, although exceedingly interesting, it would be impossible to incorporate in these notes in any logical sequence.

Crystallographic News.—Quite a number of new measurements of crystals have recently been made by Mr. E. S. Dana.

GOLD[2] from the White Bull Mine in Oregon possesses the form 3O3. The crystals are distorted so as to assume a rhombohedral symmetry. Crystals of gold from California showed a persistence of the hexakisoctahedron $18O\frac{9}{8}$.

THE BROOKITES[3] from Magnet Cove are divided for the sake of convenience into those of prismatic habit and those in which the pyramid is the predominating form. Twenty-five figures of typical crystals are pictured.

[1] Neues Jahrb. f. Min., etc., Beil., Bd. iv., 1886, p. 473.
[2] Amer. Jour. Sci., xxxii., Aug. 1886, p. 132.
[3] Ib., xxxii., Oct. 1886, p. 314.

COLUMBITE.[1]—A number of new crystals of this mineral from Standish, Maine, have been measured, and from the data thus obtained a recalculation of the axial ratio has been made. According to the new measurements, $a : b : c = .40234 : 1 : .35798$ (Schrauf's position) and $.8285 : 1 : .88976$ (Dana's position). The species is without doubt orthorhombic. Differences in composition appear to have little effect on the value of interfacial angles.

DIASPORE.[1]—The two new planes $\check{P}\frac{4}{3}$ and $\check{P}2$ were discovered on a fine crystal of diaspore from Chester, Mass.

SULPHUR.[1]—$\frac{1}{4}P$ and $\frac{3}{5}P\bar{3}$ are described as new forms on sulphur from Rabbit Hollow, Nev.

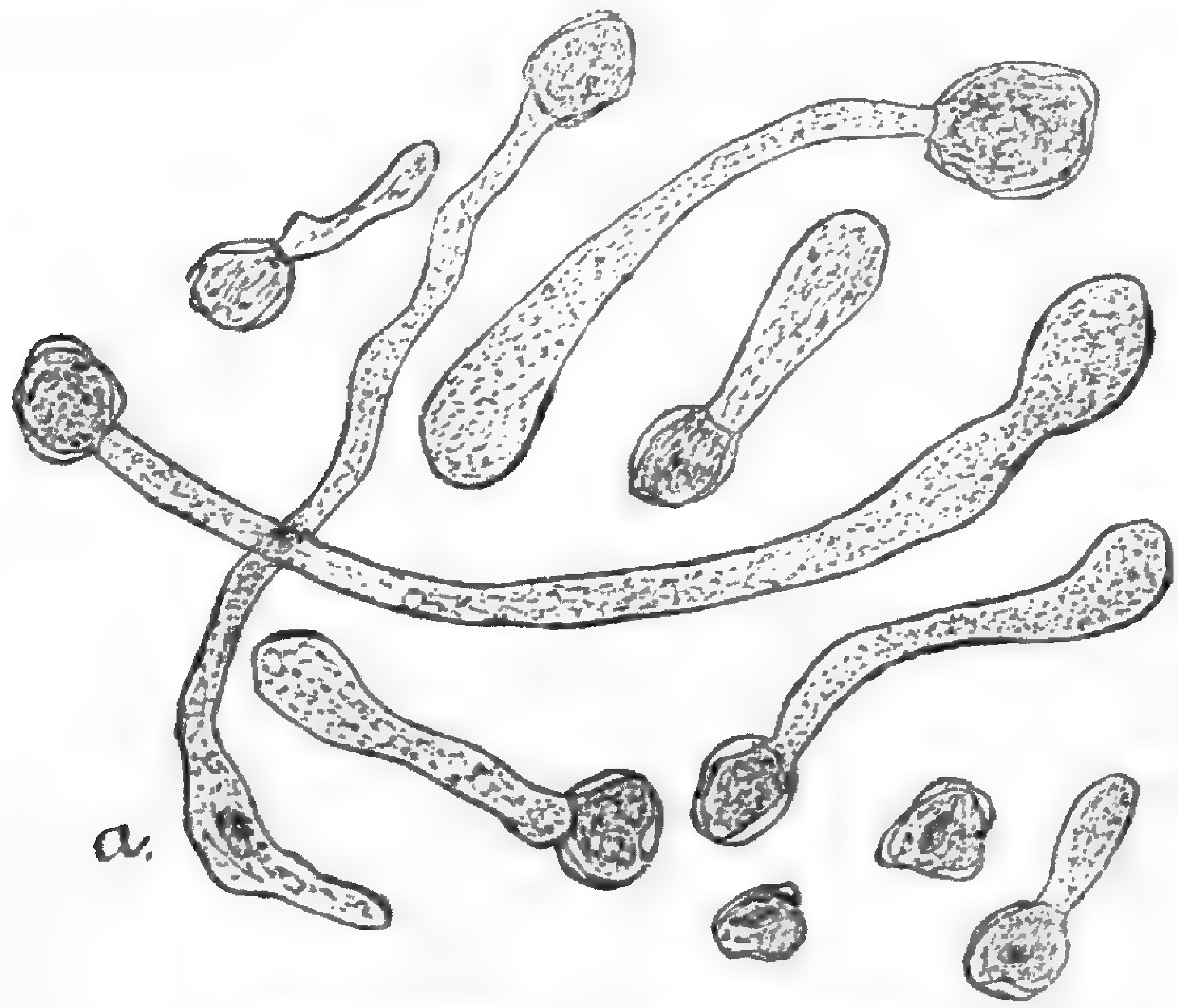
——Among some remarkably fine crystals of *hiddenite*, *xenotime*, *monazite*, and *quartz* from North Carolina, Mr. Hidden[2] mentions having found on the latter a well-developed basal plane which yielded to Professor Des Cloizeaux, $OP \wedge R = 128°$, the calculated angle being $128° 13'$. On black *tourmaline* from Sharpe's township, Alexander County, the new form $\frac{3}{5}R$ was detected. On *xenotime* from the same county $\dot{3}P$ was found, and on *herderite* from Stoneham, Maine, the new plane $P\bar{\infty}$. A twinned crystal of *molybdenite* from Renfrew, Canada, suggests that this mineral may crystallize in the hexagonal system with its planes hemimorphically developed.

BOTANY.[3]

Pollen-Tubes of Lobelia.—In the AMERICAN NATURALIST, vol. xx. page 644, the pollen-tubes of *Lobelia syphilitica* were shown in the tissue of the style with enlarged or club-shaped tips. The hope was then expressed of germinating the pollen this summer, and determining the shape of the tubes when growing freely in the sugar solution. The *L. syphilitica* not being at hand, flowers of *L. cardinalis* were examined, and in every open flower the pollen within the tube made by the union of the anthers was found germinating in great abundance. The accompanying engraving shows a number of these pollen-tubes illustrating the various characteristic forms. The prevailing shape is like that of *L. syphilitica* as found penetrating the conductive tissue of the style. The nucleus of the pollen-grain is well brought out by acid azo-rubin, and in nearly all cases was found centrally located and varying from oblong to kidney-shaped. In only a few instances had the nucleus passed out of the pollen-grain. At *a* is shown a nucleus in an enlarged place in the tube near the tip. The three lower and right-hand grains are drawn as seen after the nucleus has taken the dye.

[1] Amer. Jour. Sci., xxxii., Nov. 1886, p. 386.
[2] Ib., xxxii., Sept. 1886, p. 204.
[3] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

It remains to be seen what the shapes of the pollen-tubes are in the *L. syphilitica* when growing free from the tissue of the style. Several flowers of *L. cardinalis* were examined before the corolla had opened, and in none were the pollen-grains germinating. A careful examination of the styles, ovaries, and ovules of flowers containing germinating pollen in the anther-tube but not yet having the stigmatic surface protruding beyond the anthers, and therefore unexposed, did not show any signs of fertilization. The pollen-tubes were often extending over the surface of the style, but they were not found penetrating its tissue.



Pollen-tubes of *Lobelia cardinalis*.

Less than half an inch of rain has fallen in this locality during the past eight weeks, and, therefore, these plants are passing through an unusual drought. There is a lack of vitality in these plants as a whole, and the flowers are apparently unable to fully perform their functions. The rosette of hairs on the style just below the stigma fails to carry up the pollen, partly because the hairs are feebly developed, and also because the stigma is not protruded to its usual length. The lobelia flower is admirably adapted for cross-fertilization, and we should not expect to find here a case of the closest kind impregnation, and yet there is sufficient suspicion to warrant further careful watching.—*B. D. Halsted, Botanical Lab. Agricul. Coll., Ames, Iowa.*

The Tree-Trunk and its Branches.—In order to determine quantitatively the general relations between the tree-trunk and its branches, the writer has in the past few years made three hundred observations on the white-oak, cottonwood, and other deciduous trees of the Northern States, and one hundred observations on the white pine in Tennessee. In each of these four hundred cases the circumference of the trunk[1] was carefully measured a few inches below the point of branching, and also the circumferences of the branches a few inches above the same point. The measurements were made a little above and below the crotch in order to avoid the extra swelling usually occurring at that point. In each instance the area of the trunk circumference was compared with the sum of the areas of the limb circumferences. In this way it was found that the limbs just above point of branching on the average contain eleven per cent. more wood than does the trunk just below the same point. This general fact may be somewhat interesting, but it is not very significant. In the economy of the tree, constantly strained and bent by the wind, strength is far more important than mere bulk. In order to determine the relative strength of the tree-stem and its branches, the cubes of the trunk circumferences were compared with the respective sums of the cubes of the corresponding limb circumferences.[2] This comparison showed that in ninety-five per cent. of the four hundred observed cases the trunk just below the crotch was stronger than all the limbs just above the same point. And on the average the trunk was found to be thirteen per cent. stronger than the sum of all its branches coming from one point. Now practically just above the crotch the branches have to support the same burden as does the trunk just below that point, then why is the trunk made stronger than its limbs? Well, even if a branch or several branches are broken by the wind, the tree can still grow and reproduce its kind, but if the trunk be broken the tree receives a much greater injury. Thus in general although the limbs of a tree are more bulky than the main stem, yet at practically the same elevations the trunk, by the constant action of the wind, is kept decidedly stronger than all its branches.—*B. F. Hoyt, Manchester, Iowa.*

The Article "Schizomycetes" in the Encyclopædia Britannica.—The twenty-first volume of the ninth edition of the "Encyclopædia Britannica" contains a valuable summary of our knowledge of the Schizomycetes, from the pen of H. Marshall Ward. In this discussion the writer considers the Bacteria only, evidently agreeing with many modern writers in considering the Yeast Fungi (Saccharomycetes) as having stronger affinities elsewhere than with the Bacteria. In a short historical introduction, it is stated that "Leeuwenhoek figured Bacteria as far back as the seventeenth century, and O. F. Müller knew several important forms in 1773, while Ehrenberg in 1830 had advanced to the commencement of a scientific separation

[1] Any relatively large part of the tree having branches was considered as a trunk, and several observations were frequently made among the larger limbs of the same tree.

[2] According to an established principle of mechanics, the strength of solid bodies of same form and substance is in proportion to the cubes of their like dimensions.

and grouping of them, and in 1838 had proposed at least sixteen species, distributing them into four genera." Cohn's work (1853–1872) gave us the first really accurate knowledge of these organisms. He assumed the practical constancy of the forms met with, and accordingly described them as species and genera, taking *form* for his principal character. Later students of the Bacteria have shown that Cohn's species and genera often occur as phases in the life-history of a particular bacterium. What the specific limits are in many cases has not yet been determined. Zopf showed several years ago that "minute spherical cocci, short rodlets ('Bacteria'), longer rodlets ('Bacilli'), and filamentous forms ('Leptothrix'), as well as curved and spiral threads ('Vibrio,' 'Spirilum,' etc.), occur as vegetative stages in one and the same schizomycete."

With these facts before us, it is at once evident that Cohn's classification breaks down entirely. No stable arrangement can be hoped for in the present state of our knowledge. Accordingly, a good deal of attention is now directed to the study of the various vegetative and reproductive states, including also the details as to their parasitic and saprophytic habits, and their deportment under cultivation. The chief vegetative forms are the following, viz.:

Cocci, spherical or spheroidal cells.

Rods or rodlets, slightly, or more considerably elongated cells.

Filaments, elongated cylindrical cells, united end to end in long threads.

Curved or spiral forms, rods or filaments more or less curved.

To these should be added the so-called zooglœa, or resting stage, in which the cell-walls swell up and form a gelatinous matrix. Spores are known to occur in most Bacteria, and these have been observed to germinate in several forms. Two principal types of spore formation are distinguished, viz.: 1, by the breaking up (fission) of the filament into its ultimate segments or joints (arthrospores); 2, by the formation of spores within the cell or filament (endospores).

The provisional outline of a classification of Bacteria given is a modification of De Bary's, as follows, viz.:

Group A. Asporeæ.

No spores distinct from the vegetative cells.

I. Coccaceæ, including the genera, 1, *Micrococcus*; 2, *Sarcina*; 3, *Ascococcus*.

Group B. Arthrosporeæ.

Spores produced by segmentation.

II. Arthrobacteriaceæ, including, 4, *Bacterium*; 5, *Leuconostoc*; 6, *Spirochæte* (?).

III. Leptotricheæ, including, 7, *Crenothrix;* 8, *Beggiattoa;* 9, *Phragmidiothrix* (?); 10, *Leptothrix.*

IV. Cladotricheæ, including, 11, *Cladothrix.*

Group C. Endosporeæ.

Spores produced within the cells or filaments, including, 12, *Bacillus;* 13, *Vibrio* (?); 14, *Spirillum.*

In their relations to diseases the writer of the article unequivocally accepts the view that they are the cause, not the accompaniment. As to the mode of action he says, "If it [a bacterium] robs the blood or tissues of oxygen or of any other valuable constituent, or if its activity results in the excretion of poisonous substances, or in their formation as products of degradation of the matrix, or if it simply acts more or less as a mechanical obstruction or irritant,—in any of these cases harm may result to the delicately adjusted organism of the host." But "the living tissues of a healthy animal exert actions which are antagonistic to those of the parasitic invader; and it is now generally admitted that the mere admission of a Schizomycete into an animal does not necessarily cause disease. Were it otherwise, it would be difficult to see how the higher organisms would escape at all."

Botanical Journals.—The writer of this note has had during the past seventeen years, the period covered by his botanical teaching, many inquiries from beginners in botany as to what botanical journals it would be best for them to read. The replies have varied according to what appeared to be the individual needs of the inquirers. Recent inquiries from young botanists in widely-separated localities suggest the need of a short paper by way of guidance to those who would, if they could, read one or more botanical journals.

Nowadays, in any line of work, one who wishes to be progressive must read the proper journals. The young teacher who expects to keep up with the discoveries in his specialty without reading some of the journals devoted to that specialty will find himself in a few years hopelessly behind his reading fellow-workers. He must read, and he must read the best. He cannot afford to read anything less than the best. What shall he read? In answer to this it may be said that it is the duty of every teacher to so far hold his "specialty" in check that he shall be first and foremost a *botanist*, one who has knowledge of, and an interest in, all portions of the great science of plants. Let him be primarily a botanist, and then, if he has the inclination, secondarily a phanerogamist, a caricologist, a pteridologist, a bryologist, a lichenologist, a mycologist, an algologist, a phytotomist, or a vegetable physiologist, etc. The teacher may, and probably should be, a specialist, but he must be a botanist in the broadest sense first. His duty to his pupils is to instruct them in botany,—

the science of plants,—not in some narrow department of it. He must lay the foundation for *any* specialty, not for a particular one. Some of his pupils will become phanerogamists, some caricologists, some graminologists, some pteridologists, and so on, and he must be ready to guide them intelligently in their work. He must keep himself well informed in every department of the science.

There are three journals in the United States devoted entirely to botany. They occupy somewhat different fields, and accordingly have different values for different people. *The Botanical Gazette*, now eleven years old, is "devoted to all subjects which relate to botanical science." From the beginning the structural and physiological side of botany has been emphasized as much as possible, but the systematic botany of all the grand divisions of the vegetable kingdom has received due attention. From this journal the young botanist will obtain a very good idea of modern botany in all its departments. *The Bulletin of the Torrey Botanical Club* is the oldest of our botanical journals. For many years it was, as its name indicates, devoted mainly to local botany, being the organ of a botanical club in the city of New York. Systematic botany has always predominated in this journal, and its pages contain the descriptions of many new species. Since 1880 it has been given a wider range, and now includes papers on all botanical subjects, and is well adapted to help the young botanist. These are the best botanical journals for the teacher, with which the present writer is familiar in any country. There is nothing abroad which comes near to them in general helpfulness. *The Journal of Botany* (London) is practically confined to the systematic botany of the flowering plants and the pteridophytes, and for those teachers who are solely interested in this phase of the science this journal will be found very valuable. The *Botanische Zeitung* is almost entirely given over to the anatomical and physiological side of botany. *Flora* (Regensburg), with much the same tendency as the last, includes many papers on systematic botany.

Of special journals,—*i.e.*, those devoted to particular branches of the science,—we have one in the United States, viz., *The Journal of Mycology*, now two years old. As its name indicates, it is devoted exclusively to the botany of the fungi. Thus far special attention has been given to the description of new species and synopses of various families, with descriptions of the species. It is indispensable to the student of the fungi. The English journal, *Grevillea*, takes a wider range, aiming to be a "record of cryptogamic botany and its literature." Its articles are for the most part systematic, relatively few of them being structural or physiological. *Hedwigia* (Dresden) is much like *Grevillea* in plan and execution. A most valuable special periodical, of an entirely different character, is the *Journal of the Royal Microscop-*

ical Society, which contains (in addition to much other matter) summaries of current botanical researches, including the anatomy and physiology of phanerogams and cryptogams, and the systematic botany of the latter.—*Charles E. Bessey.*

ENTOMOLOGY.

Preliminary Descriptions of Ten New North American Myriapods.—The following new species are in the Museum of the Indiana University; they have been collected by different persons from various parts of the United States; those from Bloomington, Ind., being obtained by myself. The types of these will be deposited in the Smithsonian Institution.

1. *Lithobius howei* n. sp.—Brown; antennæ 20 jointed; ocelli 25–7; prosternal teeth 6; coxal pores 5, 5, 6, 5; spines of the first pair of feet 2, 3, 2; penultimate lost; last 1, 3, 3, 1; length 15 mm. *Hab.* Fort Snelling, Minn. (W. D. Howe.)

2. *Lithobius pullus* n. sp.—Brown; antennæ 20 jointed; ocelli 12–5; prosternal teeth 4; coxal pores 3, 4, 3, 3–2, 2, 2, 2; spines of the first pair of feet 1, 3, 2–1, 2, 1; penultimate 1, 3, 3, 2–1, 3, 3, 1; last 1, 3, 3, 1–1, 3, 3, 0; claw of the female genitalia tripartite; length 9–11 mm. *Hab.* Bloomington, Ind.

3. *Lithobius minnesotæ* n. sp.—Brown; antennæ 20 jointed; ocelli 13–6; prosternal teeth 4; coxal pores 4, 5, 5, 4; spines of the first pair of feet 1, 3, 2; penultimate 1, 3, 3, 1; last 1, 3, 2, 1; claw of the female genitalia tripartite; length 16 mm. *Hab.* Fort Snelling, Minn. (W. D. Howe.)

4. *Lithobius trilobus* n. sp.—Brown; antennæ 20 jointed; ocelli 22–8; prosternal teeth 4; coxal pores 3, 4, 4, 3–3, 4, 4, 4; spines of the first pair of feet 1, 3, 1; penultimate 1, 3, 2, 1–1, 3, 1, 0; last 1, 3, 1, 0; claw of the female genitalia tripartite; length 10–11 mm. *Hab.* Bloomington, Ind.

5. *Lithobius proridens* n. sp.—Yellow-brown; antennæ 24–29 jointed; ocelli 15–6; prosternal teeth 10–12; coxal pores 4, 6, 5, 5–3, 4, 4, 3; spines of the first pair of feet 3, 3, 2–2, 3, 1; penultimate 1, 3, 3, 2–1, 3, 3, 1; last 1, 3, 3, 2–1, 3, 3, 1; claw of the female genitalia whole; length 10–12 mm. *Hab.* Bloomington, Ind.

6. *Lithobius cardinalis* n. sp.—Brown; antennæ 20–31 jointed; ocelli 10–6; prosternal teeth 4; coxal pores 2, 4, 3, 2–2, 2, 3, 2; spines of the first pair of feet 2, 3, 2; penultimate 1, 3, 3, 1; last 1, 3, 3, 2–1, 3, 3, 1; claw of the female genitalia tripartite; length 6–9 mm. *Hab.* Bloomington, Ind.

7. *Scolioplanes ruber* n. sp.—Bright red; attenuated anteriorly and posteriorly; sternum cordiform; frontal plate present; prebasal plate concealed; ventral plates with a large, median foveola; pairs of feet in the male 67–69, female 71–73; length 53 mm. *Hab.* Bloomington, Ind.

8. *Iulus ellipticus* n. sp.—Resembles *I. impressus.* Vertex with

a median sulcus; eyes nearly elliptical; ocelli about 55, in 8 series; segments 46; first segment semicircular, not striate; anal spine stout, projecting beyond the valves; length 25 mm. *Hab.* Fort Snelling, Minn. (W. D. Howe.)

9. *Iulus burkei* n. sp.—Rather stout; brown, with a series of dark dots on each side; vertex with a median sulcus; eyes triangular; ocelli 17, indistinct, in 4 series; segments 45–47; first segment produced forward to the eyes, not striate; last segment rounded; anal valves marginate; length 14 mm. *Hab.* Ukiah, Cal. (J. K. Burke.)

10. *Fontaria virginiensis brunnea* n. var.—This new variety can be easily distinguished from *virginiensis* by its color and form of last segment. Chestnut-brown, lateral plates and under parts yellow, a black, median dorsal line; last segment very blunt, sparsely pilose.—*Charles H. Bollman, Indiana University, Nov. 27, 1886.*

Mimicry in a Caterpillar.—S. E. Peal, writing from Assam to *Nature*, notices a singular case of mimicry on the part of a caterpillar, which, when suddenly surprised, erects its head in an attitude that caused the writer to mistake it for a shrew, probably the very animal that preys upon it. The resemblance is caused by two lateral prolongations and a pointed tip to the head; these when lifted in the peculiar attitude assumed simulate ears and a long muzzle, while the mouth parts in profile look like the mouth of a vertebrate.

The same writer states that the tiger causes the Sambur deer to run to it by uttering a whistle which only an expert can tell from that of the deer. The eye and nose lumps of a crocodile are so like lumps of foam that Mr. Peal confesses he has been deceived until he saw the supposed foam sink. He believes this simulation useful to the crocodile in obtaining its food.

A female chimpanzee in the Bidel menagerie, now at Paris, has been seen to weep as the climax of her grief when deprived of a child playmate.

ZOOLOGY.

A. S. Packard on the Cave Fauna of North America, with Remarks on the Anatomy and Origin of Blind Forms.[1]—The author briefly describes some of the larger caves, with notes on their hydrography, temperature, origin, and geological age, the food-supply of the inhabitants, the means of entering or colonizing the cavern, and lists of each cave fauna. These notes are followed by a systematic description of the animals and their geographical distribution. A comparative list of American and European cave animals shows that in America there are about sixty-two species to about one hundred and seventy-five in

[1] Abstract of a paper read before the National Academy of Sciences, November, 1886.

Europe, though ninety of the latter belong to the genera Adelops and Anophthalmus. A preliminary list of blind non-cavernicolous animals, including deep-sea forms, enumerates less than two hundred species. Under the head of Anatomy of Blind Cave Arthropoda, the following changes in the eyes, optic ganglia, and optic nerves occur in forms living in total darkness: (1) Total atrophy of the optic ganglia and optic nerves, with or without the persistence in part of the pigment (or retina), and the crystalline lens (Cecidotæa, Crangonyx, Adelops, and Pseudotremia). (2) Persistence of the optic lobes and optic nerves, but total atrophy of the rods and cones, retina and facets (*Orconectes pellucidus* and *hamulatus*). (3) Total atrophy of the optic ganglia, optic nerves, and all the optic elements, including rods and cones, retina and facets (Anophthalmus, Scoterpes, and (?) Anthrobia).

It was shown that the blind cave fauna as a whole must have originated from animals living in the upper world at the mouth of the caves or their vicinity. It was shown that there is a more or less exact parallelism between blind cave animals and blind or eyeless deep-sea forms, and the abyssal blind species of the Swiss lakes, as recently proved by the researches of naturalists; the abyssal marine as well as lake species are probably the descendants of immigrants from the well-lighted waters of moderate depths which have become adapted to their abnormal abyssal surroundings. In respect to color as well as loss of visual organs, and often in the elongation of appendages, certain deep-sea forms, at least, appear to resemble many cave forms, the increased tactile sense compensating for the loss of the power of sight. From what is known of the habits of blind or eyeless animals, whether living in caves, in the sea, or in lakes, or in the upper world in the soil or under stones, all are modified in much the same manner, and this is due to similar causes, the most prominent being the absence of light.

Notes on the Distribution of Shells.—From 1880 to the present year I have often collected shells about Eureka Springs, in Carroll County, Arkansas, and in the Kansas City *Review of Science* for 1883 I published a list of forty-two species, not including the Unionidæ, found in that county. Last March—15th to 27th—I made a trip through a number of the counties of Arkansas, commencing with Carroll and extending from there along the western line of the State, Benton and Washington being north of the mountains, Crawford south of them but on the north side of the Arkansas River, and Sebastian on the south side of it. Hot Springs is in Garland County, Hot Springs County south of it, and Jackson County north of Little Rock, on the Iron Mountain Railroad. The following list gives the result of a large amount of searching, though the total time given to it in Carroll County was many times that in any of the other counties.

Mesodon. In Carroll County I have gathered six species of this sub-genus, but not more than two in any of the other counties. Of *albolabris* I got many in Carroll County, most of them of a large size, though on the higher grounds a small variety was found, and also a variety named *alleni* by Professor Wetherby. In Garland County I got a couple of shells of somewhat smaller size than the largest from Carroll County, and darker color. Of *exoleta* I found a small size in Carroll County. For some time after the lip is fully formed the shell is thin, and has no parietal tooth, but it afterwards thickens, and a rather heavy tooth appears. In Washington County I found a single specimen, which was only 19–15 mm. diameter. Of *thyroides*, the same statement in regard to thickness and parietal teeth as in the last is true. This species was originally described as of 22–19½ mm. diameters, but I have it from Indiana 28–23 mm., and from Ohio and Missouri nearly as large. From Carroll County the shells were 22–19 mm., and these have been identified as *bucculentus*, though this is the typical size of *thyroides*. Two shells from Sebastian County were of the same size, and, though apparently mature, they had no parietal tooth. From Jackson County they were larger, being 24–20 mm., and from Benton County were the smallest I have yet seen,—18–15 mm,—one having a parietal tooth, and three others having none; these latter can scarcely be distinguished from *clausus* except by the height. The rare *divestus* was not uncommon in Carroll County; the size, 18–15 mm. From Franklin and Garland Counties they were nearly as large, while from Benton they were only 15–13 mm. I found *elevatus* in Carroll and Jackson Counties, and *clausus* in Carroll only.

Patula perspectiva Say. In abundance in Carroll County; a single one found in Benton County.

Patula alternata Say. In Carroll County it does not differ much from the northern specimens, but in Washington and Garland Counties it is much heavier ribbed, and has darker spots.

Stenotrema leaii Ward. In Carroll, Benton, and Washington Counties.

Stenotrema labrosa Bld. In considerable abundance in Carroll County; also found in Washington, Crawford, and Garland.

Triodopsis inflecta Say. In Carroll County, of light color and 11–10 mm. diameter. Similar but darker colored ones from Benton, Washington, and Franklin Counties. In Garland and Hot Springs Counties each I found one, 12–10 mm. diameters, but looking much larger on account of their height. From Jackson County I have one, 14–11 mm. and elevated, though others from the same place are of the ordinary shape and only 10–9 mm. diameters.

Triodopsis appressa Say. From the bluffs of the White River, in Carroll County; these shells are thin and of a very light horn color, with no indication of tooth on the peristome, even on the basal side, and with striæ very fine, so that the shell is somewhat glabrous. Largest, 21½–18 mm., and of nearly six whorls. On the bluffs of the Arkansas River, in Crawford County, the same variety is found, the largest observed being 19–16 mm. From Jackson County the shells are much more elevated, of a reddish horn color, with strong, rib-like striæ, and with tooth on basal side of the peristome more pronounced than in the typical shell, and with peristome heavier and more reflected. Size, 19–16½ mm., and five whorls.

Polygyra jacksoni Bland. This rare shell was found in Carroll County in considerable abundance among the gravel and small stones on the hillsides, and rarely under large stones; the size was typical, the largest being about 7 mm. diameter. In Washington County it was about the same size, but on the bluffs of the Arkansas River, in Crawford County, they were much larger, the largest being 8–7 mm. and the smallest 8–7 mm. diameter. They were plenty, and found under large stones. In Sebastian County they were nearly as large.

Polygyra dorfinelliana var. *sampsoni* Wetherby. In Carroll County I have gathered this shell in large numbers, sometimes getting fifteen or twenty under a single stone. They varied in size from 10½–8¾ mm. to 7–6¼ mm. diameter. In Benton and Washington Counties I found a few, and in Crawford County, where the *jacksoni* were of such large size, I got a single one, and it was 8–7 mm. diameter.

Polygyra leporina Gld. In Sebastian County, where I found three specimens of this and of two other species of *Polygyra*.

Bulimulus dealbatus Say. In Carroll and Crawford Counties.

Zonites. Of *arboreus* I got specimens in Carroll, Garland, and Hot Springs Counties; of *indentatus*, in Carroll and Benton Counties; of *friabilis*, in Carroll and Garland Counties; of *demissus*, in Garland County; of *gularis*, in Hot Springs County; and of *ligera*, in Jackson County.

Pupa. I found *fallax*, *armifera*, and *contracta* in Carroll, and the latter in Benton County.

In addition to the foregoing, the following land shells occur in Carroll County: *Patula solitaria* Say; *Triodopsis fallax* Say, variety *minor*; *Strobila labyrinthica* Say; *Macrocyclis concava* Say; *Succinea ovalis* Gld.; *S. verrilli* Bld. (?); *Helicina orbiculata* Say; *Pomatiopsis lapidaria* Say; *Tebenophorus carolinensis* Bosc; and *Limax campestris* Binn.

Of fresh-water shells, I found an abundance of some species, especially in Carroll County. Mr. C. F. Ancey, of France, has described *Physa albofilata* from Eureka Springs. I gathered the same species in Washington County. *Physa heterostropha* and *P. gyrina* were found in Carroll, and the latter in Benton, Washington, and Hot Springs Counties. *Limnæa humilis* was found in Carroll County and *L. columella* in Washington and Hot

Springs Counties; *Planorbis trivolvis* in Carroll and Washington Counties; and *P. bicarinatus* in Carroll and Hot Springs Counties; *Ancylus tardus* in Carroll, Benton, and Washington Counties; *Campolema ponderosa* Say, in Jackson County, *coarctata* Lea, in Carroll and Hot Springs Counties; *Sphærium transversum* and *Pisidium* (?) in Carroll County.

Pleurocera subulare Lea. In White River and King's River, in Carroll County, the latter being much the larger. Two or three species from Ouchita River, Hot Springs County, not yet identified.

Goniobasis. Specimens of what have been identified as *pallidula* were very plenty in White and King's River, in Carroll County, and what have been identified as *saffordi* in Washington and Hot Springs Counties.

I have some Unionidæ from three counties, but will not attempt now to make a list of what may be found in the State.—*F. A. Sampson, Sedalia, Mo.*

The Characteristics and Relations of the Ribbon-Fishes.—I have been very much interested in the monograph by T. Jeffery Parker "On the Skeleton of Regalecus argenteus" published in *T. Z. S.* (xii. pt. 1). For some years I have mentally set apart the genera *Regalecus* and *Trachypterus* (which I consider to represent distinct families) as a suborder of Teleocephali, and indicated it in 1885, under the name Tæniosomi, in the Standard Natural History (iii. 265), although I could only give external features. Parker's memoir shows that the type is characterized by the basis cranii being simple (there being no basisphenoid), post-temporal not bifurcate, hypercoracoid or scapular foramen marginal, and between the hypercoracoid and hypocoracoid, superior pharyngeals 4, subvertical, none greatly developed, and dorsal rays inarticulate. These characters thus contrast with all other subordinal divisions of the Teleocephali. In addition, the branchihyal apparatus is distinguished by the intercalation of persistent cartilaginous elements, so that Parker recognizes eight pieces in the copula instead of the normal four: "parabranchial" elements (to use Parker's term) are superadded to the first and second epipharyngeals, and the fifth arch has reverted to the original type, and lost its specialization as dentigerous pharyngeal bones. In fact, the segregation of the Trachypteridæ and Regalecidæ from the other fishes into an independent suborder seems well merited. I doubt very much whether the Stylephoridæ belongs anywhere near the group; it is a pity the genus cannot be re-examined. Another point has occurred to me. I am half inclined to think that the Heterosomatous fishes may have branched off from the original stock, or progenitors of the Tæniosomous fishes. I shall investigate the subject when I can get the requisite material.—*Theo. Gill.*

The Hyoid Structure in the Amblystomid Salamanders.—My attention was recently called by my friend Dr. Eleanor Galt to the fact that the figures of the hyoid apparatus of *Amblystoma punctatum* given by Drs. Parker and Wiedersheim are not correct. The latter ("Das Kopfskellet der Urodelen," pl. v. f. 75) represents the hypohyal cartilages as forming the posterior parts of a cartilaginous circle, from which two recurved processes on each side extend, the anterior approaching the ceratohyal, the posterior returning towards the basibranchial. Parker omits the annulus altogether. Now, as Dr. Galt points out, there is a cartilaginous ring which supports the circumference of the tongue in this genus in a manner different from anything known in any other genus of Batrachia. But it is not connected in any way with the hypohyals, but issues from each side of the basibranchial, posterior to them, and supports the tongue above the basibranchial level. It sends out one lateral process on each side (Fig. 1) which does not connect with the ceratohyals.

On examining other species of Amblystomidæ, Dr. Galt found the same character present in *A. talpoideum*, *A. opacum*, *A. tigrinum*, and *A. macrodactylum*. In *A. tenebrosum* she found a very dif-

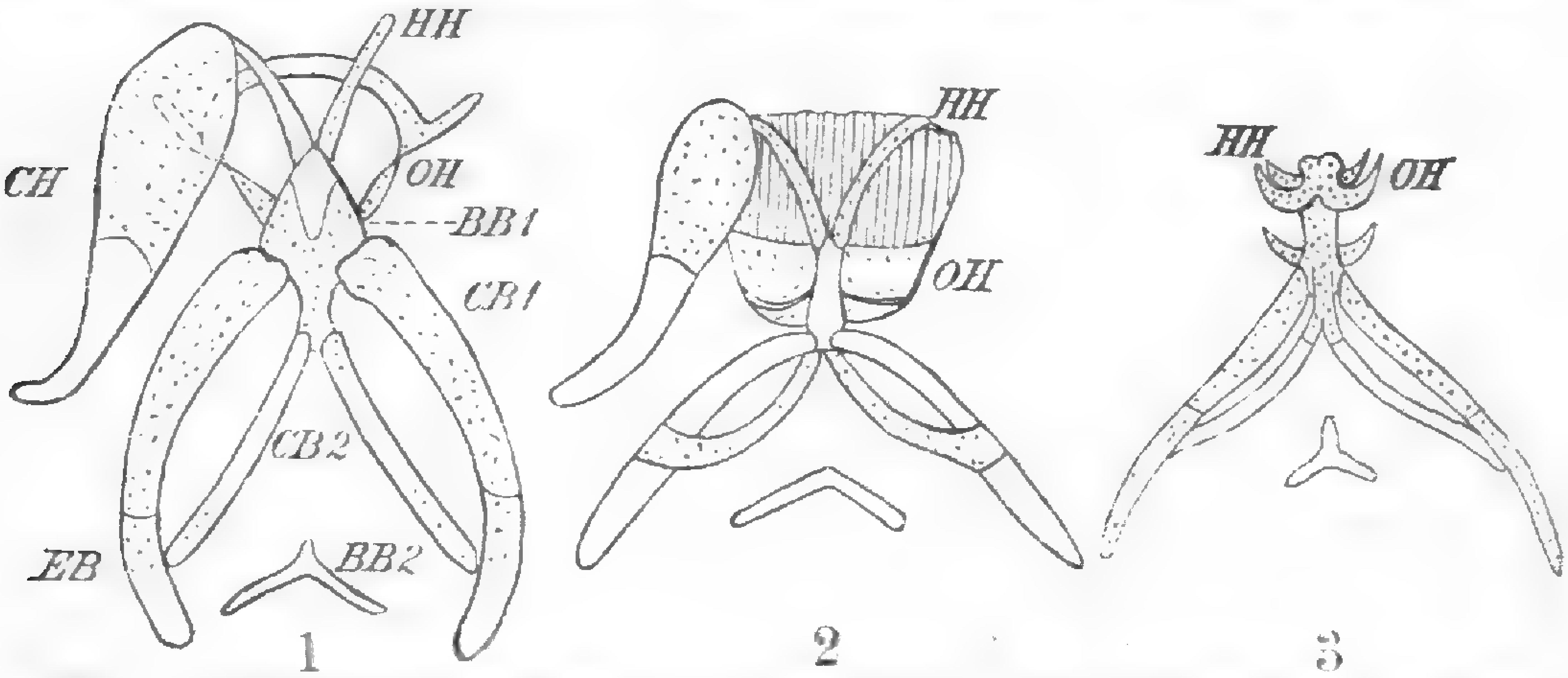


Fig. 1, *Amblystoma punctatum* × 2, from below. Fig. 2, *Chondrotus tenebrosus* $\frac{1}{1}$, from below. Fig. 3, *Linguælapsus annulatus*, × 2, from above. CH, Ceratohyal; HH, hyphohyal; OH, otohyal; BB1, first basi-branchial; BB2, second basibranchial; CB1, first cerato-branchial; CB2, second cerato-branchial; EB, epibranchial.

ferent structure. There is no annulus, but its basal part remains in the form of a plate on each side of the middle line, the external angle of which represents the external process of the ring of *Amblystoma punctatum.* To the straight anterior border of this cartilage is attached a sheet of fibrous tissue, the fibres being distinctly antero-posterior in direction, and forming the basement tissue of the tongue. The cartilage, handle-like in this species, and ring-like in the *A. punctatum*, is not homologous with any of those which have received names, so I propose to call it the otoglossal cartilage.

These observations of Dr. Galt induced me to examine some of the other species referred to Amblystoma, and I report the following results. The following species have the otoglossal cartilage essentially like that of *A. tenebrosum*: *A. aterrimum*, *A. paroticum*, *A. decorticatum*, and *A. microstomum*. As the type is so entirely different from that of Amblystoma proper, I propose to separate these species under the distinct generic name Chondrotus, with *C. tenebrosus* as the type. Examination of the species recently described as *A. annulatum* and *A. lepturum*,[1] shows that they represent a third genus quite distinct from either of the preceding. Here the otoglossal cartilage (Fig. 3) has somewhat the form of the basal part of that of Chondrotus, but it is entirely free from the basibranchial bone, sliding on it in obedience to the contractions of the pubohyal and genioglossal muscles. This genus I propose to call *Linguælapsus*. I know but two species of it.

According to the figures given by Wiedersheim (*l. c.*), Hynobius and Ranidens do not possess an otoglossal cartilage, agreeing in this respect with the Plethodontidæ. Wiedersheim also shows that the second epibranchial is distinct in these genera, and that the stapes is connected with the quadrate cartilage as in Cryptobranchus. I therefore think that the Hynobiidæ may be retained as distinct from the Amblystomidæ. How many genera it embraces is as yet uncertain.—*E. D. Cope.*

Color of the Eyes as a Sexual Characteristic in Cistudo carolina.—Naturalists interested in our native land-tortoise must often have noticed the bright-red eyes in some individuals. I have seen them so vivid in color as to attract the attention before any other character. In other tortoises of this species the eyes are brown and sometimes gray, so that from bright red through the browns to gray may be considered the extent of color variation.

Some time ago I commenced taking notes as to sex and color of the iris in all the specimens of *Cistudo carolina* met with, and found that the males had red eyes, while those of the opposite sex were for the most part brown or gray. The following were the colors assigned to the eyes, as I observed them at the time of finding the tortoises, and though I have used the word "scarlet" twice, perhaps very bright red would be more correct, though I will leave the characters as originally noted.

Staten Island,	July,	1885.	Full-grown specimen,	male,	eyes bright red.
"	"	"	" "	"	" scarlet.
"	"	"	" "	female,	eyes reddish brown.
"	"	"	" "	"	" brown.
"	"	"	One-fourth grown specimen,	female (?),	eyes brown.
"	Aug.,	"	Full-grown specimen,	female,	eyes reddish brown.
New Jersey,	Sept.,	"	" "	male,	" red.
"	July,	1886.	" "	female,	" dark gray.
Staten Island,	June,	"	" "	"	" "
"	Oct.,	"	" "	male,	" scarlet.

I believe these tortoises have a particular fondness for certain locations, for on Staten Island I know of two places where they

[1] Cope, Proc. Amer. Philosoph. Soc., 1886, p. 524.

are particularly numerous, though they occur sparingly over the entire island. These favorite haunts are some twelve miles apart, and differ considerably as to the character of the soil, one being sandy, while the other is a rich wood loam. They present some characters in common, however, for in both the trees are small, with many open, grassy spots, and there are also some permanent wet places. These tortoises require water just as much as common rabbits do, and people who keep them captive in their cellars without giving them any, because they found them on the hill-top, subject them to a needless torture. If water is given them, they will quickly stick their heads into it, and then hold them upright as birds do when drinking.

In autumn they do not always dig under the soil to pass the winter in this locality, but will hibernate in a hollow or any place where a thick mass of leaves has collected. I found one on the 8th of February, 1885, in such a location, with but few leaves for a covering.—*William T. Davis.*

On the Morphogeny of the Carapace of the Testudinata.—Preliminary to a more extended paper on the group Athecæ of the Testudinata, allow me to give the following results, which seem to be of considerable interest:

The Dermatochelydæ (Sphagididæ) are characterized by the development of *independent* superficial dermal bones. In *Dermatochelys coriacea* and the allied extinct forms we find a pavement of small osseous plates extending over the whole shield, jointed to each other by more or less fine sutures. The number of these plates is very much larger than that of the other Testudinata, which never have more than seventy.

In all other Testudinata we find the carapace connected with the internal skeleton. That the carapace of the Dermatochelydæ is homologous to the carapace, without internal skeleton, of the rest of the Testudinata, there is no doubt; that the carapace of the "Thecophora" (Dollo) has developed from the carapace of the "Athecæ" is proved by a specimen of *Eretmochelys imbricata*. In this specimen I find small polygonal plates of the same shape as those of Dermatochelys suturally connected with the third, fourth, fifth, and sixth costal plates.

A form between the Dermatochelydæ and "Thecophora" (Dollo) is represented by the oldest known turtle *Psephoderma alpinum* H. v. Meyer, from the Triassic of the Bavarian mountains, preserved in Munich. In this highly-interesting specimen, never mentioned in monographs on the Testudinata, we have certainly not less than one hundred and ninety-three plates suturally united.[1]—*Dr. G. Baur, Yale College Museum, New Haven, Conn., October* 6, 1886.

[1] It is important to mention that Dermatochelys has the nuchal plate developed besides the mosaic-like carapace. According to Gervais, this plate is covered by

Collections of Humming-Birds.—Hans von Berlepsch has some critical remarks on the humming-bird literature in the "Festschrift of the Cassel Vereins für Naturkunde," 1886. According to this, the largest collection of humming-birds was that of the late John Gould, which is now in the possession of the British Museum. It contained 5378 specimens, representing about 400 species. For second and third places there is a rivalry between Godman and Salvin, of London, on the one hand, and D. G. Elliot, of New Brighton, N. Y. The latter had, in 1878, 380 of the 426 known species, including many of the types of Bourcier, and many of which but a single specimen is known. Salvin and Godman's collection will shortly pass into the possession of the British Museum. Berlepsch himself has the fourth collection in size (about 2000 specimens and 350 species), and close to this is that of George N. Lawrence, of New York, which is especially rich in types.

The Nesting of Collyrio ludovicianus (Baird).—On the 10th of May, 1883, I found, in Williamstown, Mass., a nest of the Loggerhead Shrike, *Collyrio ludovicianus* (Baird). The nest was situated in a sheep-pasture, in a wild-thorn tree, at a distance of seven or eight feet from the ground, and was made from weeds, twigs, and wool, lined with hair and wool. The eggs, six in number, are a greenish-white tint, thickly marked and dotted with light brown and buff-purple spots, which on some of the eggs nearly cover the larger end. A few days later, perhaps a quarter of a mile from the first nest, a second was found, that had evidently been deserted. It contained two eggs similar to those of the former nest, and the construction and materials of the two nests were alike. Mr. H. A. Purdie, hearing of the circumstances, wrote on the 17th of May, 1883, that it was the first known instance of this bird breeding in Massachusetts. So far as I know, nothing was seen of this species in this vicinity until this spring, when I discovered a nest in an elm, perhaps ten feet from the ground, among the branches fringing the huge trunk; the nest was built of materials similar to those composing the nests found in 1883, and the bird was identified. As the last nest was within one hundred and fifty feet of the first, and all three so comparatively near, it is possible that the same pair return from year to year. At any rate, as the first recorded instance of the nesting of this species in Massachusetts, it may be of interest to ornithologists.—*Sanborn Gove Tenney, Williamstown, Mass., Nov. 27*, 1886.

Zoological News.—ECHINODERMS.—Hjalmar Theel, in his report upon the Holothuroidea of the "Challenger" Expedition, not

the carapace. If this statement is correct, we cannot consider the nuchal plate as a part of the dermal skeleton. But the question is, What is the nature of this element? It is possible that it contains the ribs of the last cervical vertebra, with which it is connected.

only describes the new species of the groups Apoda and Pedata, but adds a series of short accounts of all the forms known. Up to 1872 very few forms were known from beyond one hundred, and scarcely any from beyond two hundred fathoms. Now we know of a number met with at five hundred fathoms, and some that are abyssal. Thus *Cucumaria abyssorum* occurs from fifteen hundred to two thousand two hundred and twenty-three fathoms, *Synapta abyssorum* at two thousand three hundred and fifty fathoms, *Pseudostichopus villosus* from thirteen hundred and seventy-five to two thousand two hundred, while *Holothuria thomsoni* has been dredged from depths ranging from eighteen hundred and seventy-five to two thousand nine hundred fathoms. Some species have a wide bathymetrical distribution, individuals residing at depths of from five hundred to seven hundred fathoms presenting no notable differences from others living near the shore.

M. H. Koehler maintains that in the Ophiuridæ the madreporic gland communicates by a canal with the lower or vascular peribuccal ring, much as in the Echini. The internal epithelium of the intestine of the Ophiuridæ is very thick.

M. Gauthier maintains that the plates of the apical region of echinids cannot be depended upon as characters for the delimitation of genera and species. He gives numerous figures of the variations in the apical plates of Hemiaster, from his own observations with the microscope, to prove this. The disposition of these plates, notably that of the madreporic plate, often exhibit the variations relied on to establish species and genera.

Vermes.—*Fecampia erythrocephala* is a parasite in several Decapoda, and has been studied by M. Giard. *Carcinas mænas* is most commonly infested with it when young. It lives in the body cavity, and is often bent into a U form. Some crabs have several parasites. Sometimes it is hidden in the liver. It is 15 to 18 mm. long, with a red head, and white, slightly rose-tinted cylindrical body. When sexually mature it leaves its host, crawls on the rocks, usually on its side, and soon builds a cocoon from threads secreted by the cutaneous glands. The cocoon is most dense upon the inside, becomes brittle by contact with the sea-water, and communicates by a narrow opening with the surrounding medium. Within the posterior part of the cocoon the parasite deposits its rose-tinted eggs enveloped in a gelatinous substance. The Fecampia itself has lost much of its bulk, and the snowy tint has disappeared. This transformation takes place at the end of August, at which period the females of *C. mænas* lay their eggs.

Tunicates.—The "Challenger" Expedition collected one hundred and two species or well-marked varieties of Compound Ascidians. These are described by Professor W. A. Herdman in vol. xiv. of the Zoological Reports of that cruise. Eighty-eight of the species and ten of the twenty-five genera are new, and two new families are established. The Compound Ascidians, like the simple ones, appear to attain their greatest numerical development in the southern temperate zone. Only twelve species were met with between one hundred and two hundred and fifty fathoms, seven reached to one thousand, and one strange form, *Pharyngodictyon mirabile*, was found at sixteen hundred fathoms. Section of the middle of the post-abdomen of an *Amaræcium* shows three empty cavities, the median one running the whole width of the post-abdomen, while the others, dorsal and ventral, are of irregular section. M. C. Maurice has proved that the median of these three tubes is a dependence of the branchial cavity (epicardium), while the others are prolongations of the pericardiac cavity. The genital organs of Amaræcium are placed in the post-abdomen on the same side of the epicardiac plate and on the dorsal aspect.

FISHES.—M. Yves Delage maintains, contrary to the opinion of Gunther, that the Leptocephala are normal larvæ, capable of transformation. So far from suffering through their distance from the coast, he believes that they finally reach it after having passed through their transformation. The pollack feeds upon these larvæ.

BIRDS.—Professor C. L. Herrick ("Bull. Sci. Lab. Denison Univ.") gives an account of the osteology of the Evening Grosbeak, *Hesperiphona vespertina* Bonap., and compares it with the Pipilo. The Evening Grosbeak seems to have its home in the Saskatchewan region, but visits Minneapolis frequently, and has been seen as far east as Cleveland, O. It is highly gregarious, and the migrating colonies keep up a constant chorus of piercing, but not unmelodious notes. They seem to feed almost entirely on the seeds of the box-elder, maple, poplar, pines, and some other trees. Their note is by no means confined to evening. Another species of the genus, *H. abeillii*, lives in the mountainous parts of Mexico.

The English quarterly journal of Ornithology entitled *The Ibis*, contains in its last issue a valuable article upon the wings of birds, by C. J. Sundeval, with a synopsis of the number of arm-remiges to be found in various species; some notes upon the genus Empidonax, by Mr. R. Ridgway, describing a new species and defining eighteen known species; two papers by Mr. R. B. Sharpe on birds from Fao, in the Persian Gulf, and others from Bushire, on the same gulf; and a list of the birds obtained by Mr. H. Whitely in British Guiana, as well as some shorter papers. The total number of birds on the Guiana list is six hundred and twenty-five, of which thirty-six are migratory or sea-birds. About sixty and one-half per cent. of the remaining five hundred and eighty-nine forms occur in the Amazons valley, twenty-seven and one-half per cent. in Venezuela, thirty-three per cent. in Columbia, thirty-six and one-half per cent. in Ecuador, forty-seven and one-half per cent. in Peru, thirty-three per cent. in Southeast and Central Brazil. The West Indies have but four per cent. of the birds of Guiana, or no more than are possessed by the Argentine Republic.

MAMMALIA.—The Central American Mammalia, dealt with by the late Mr. E. R. Alston, consist of one hundred and eighty-one species; Cetacea are not included in the work. Fifty-two of these species are bats, sixty rodents, and eleven quadrumana. The last are Neotropical forms that have penetrated northward. One only, *Ateles vellerosus*, has spread into Mexico to twenty-three degrees N. lat. The cats are southern or wide-spread, the dogs all northern. Seven out of the eight known Procyonidæ are found here, the exception being *Nasua rufa* of Brazil. Four species of Cariacus, the big-horn sheep, the prong-buck, two peccaries and two tapirs are the sole Ungulata. Among edentates three kinds of anteater, an armadillo, three sloths, and seven opossums extend beyond Panama.

EMBRYOLOGY.[1]

The Formation of the Eggs and Development of Rotifers.[2]—G. Tessin has made a very important contribution to the life-history of the wheel-animalcules, which he has traced in *Brachionus urceolaris*, *Euchlanis dilatata*, *Salpina mucronata*, and *Rotifer vulgaris*, having succeeded in obtaining satisfactory sections of the embryos in a number of stages.

The large simple sac opening into the cloaca, which has hitherto been regarded as the ovarium, is, according to Tessin, not an ovary at all, but the eggs are developed on the outside of this organ from a heap of cells lying on its right side and near its anterior end. As a rule, the number of nuclei in the ovarian mass is constant, eight nuclei being the usual number; only in the fixed Tubicolariæ, Philodinæ, and Pterodina could a larger or smaller number of ovarian nuclei be made out.

In the process of maturation the nucleus of the egg gradually passes to the periphery, where it breaks up; but before it does so a nuclear spindle is developed. This process Tessin regards as an indication that polar cells are extruded, although he did not actually succeed in finding them.

None of the accounts hitherto given of the manner of segmentation are correct, according to this author. The egg is first divided transversely into two unequal cells, the cleavage plane being also slightly oblique, and the larger cell anterior, the smaller

[1] Edited by Dr. JOHN A. RYDER, Philadelphia.

[2] Ueber Eibildung und Entwickelung der Rotatorien, Zeitschr. f. Wiss. Zoologie, xliv., 1886, pp. 272–302, pls. xix., xx.

posterior. The larger cell is next divided transversely, a smaller mass being segmented from it behind. Then follows the division in twain of the smaller of the two primary cells. The four resulting blastomeres then assume a symmetrical disposition with respect to the future median axis. The three posterior smaller cells mark the future dorsal aspect of the body; the larger cell marks the position of the future anterior end.

From this point onward the segmentation is essentially meroblastic, the smaller posterior and dorsal cells segmenting and investing the larger anterior cell from behind forwards and laterally by a process of epiboly. Meanwhile, the posterior acuminate end of the large anterior cell becomes segmented into a number of cells, which take a share in the formation of the ectoderm, together with the smaller dorsal cells already spoken of. While the formation of the entoderm is thus accomplished, the most anterior row of the dorsal group are destined, as shown by later events, to form the mesoderm. By this time the larger anterior cell has been further subdivided, and its component blastomeres to the number of five, which form the rudiment of the endoderm, are included by the growth forward and downward of the advancing ectoderm. The mesodermic cells, which at first formed a transverse row at the edge of the dorsal group of ectodermic cells, are pushed farther forward and downward, and are finally thrust inward between the ectoderm and mesoderm along the anterior, or what may finally be regarded as the dorsal, border of the blastopore or prostoma. Since the mesoderm is developed in almost all bilateral forms from the entoderm, the development of it from the ectoderm in Rotifers, as here described, is probably characteristic and of taxonomic importance. A solid gastrula (sterro-gastrula) is thus formed, and the prostoma (blastopore) assumes an anterior ventral position and marks the place where the permanent mouth is developed. The genesis of the mesoderm in Rotifers is contrasted with the mode of its origin in Astacus, according to Reichenbach, at the anterior margin of the blastopore. It is thought probable that the musculature and sexual organs are developed from the mesoderm.

The blastopore assumes a quadrate form, and the ectoderm bounding it is divided into four well-marked lobes,—a right and left, an anterior and a posterior lobe. From the invaginated portion of the ectoderm, lying within the blastopore, the œsophagus (which lies in front of the mastax) and the wheel-organ or trochal disk are developed. The posterior lobe of the ectoderm becomes divided off posteriorly from the blastopore by a transverse fissure or constriction, leaving the posterior lobe free, which thus becomes the rudiment of the young Rotifer's tail. The anterior and lateral lobes, bounding the blastopore, finally blend and become differentiated into the cephalic extremity of the animal.

The metamorphosis of the entodermal mass of cells already mentioned is very remarkable. The entodermic cells form a solid globular mass, filling up for a time the hinder three-fifths of the still nearly solid gastrula. This mass is next subdivided into a sharply circumscribed anterior portion, in which the mastax is developed, and a posterior portion, from which the rest of the alimentary tract is formed.

As a result of these elaborate and apparently very successful studies, Tessin concludes that the Rotifers are not affiliated very closely with the higher Annelids, but, on the one hand, with the Turbellaria, and on the other with the Crustacea; with the former on account of the well-marked lobes around the blastopore and the mode of origin of the mesoderm, and with the latter on account of the mode of invagination of the mesoderm at the anterior margin of the blastopore, the development of a post-abdomen with a forked tip, the position and fate of the blastopore, and the somewhat similar position of the anus in some aberrant forms of Crustacea (*Cetochilus*). In summing up he concludes that the Rotifers form a special group, which should be placed somewhere between lower worms and Crustacea.

The Gestation of Armadilloes.—A very remarkable mode of uterine gestation has very recently been described by Von Jhering[1] in a Brazilian armadillo (*Praopus hybridus*). Though the notice published by this observer is a very brief one, and evidently preliminary, the conclusions arrived at are novel and of great interest, as indicating that it is possible that a mode of reproduction may occur in a mammal simulating parthenogenesis. The natives informed him that the female armadillo always produced litters of young, the individual members of which were invariably of only one sex. This observation he had been able to fully confirm and to announce that the fœtuses of a single litter are enveloped in a common chorion,[2] and, while the placenta of each fœtus is discoidal, the individual placentæ of the litter are so disposed as to form a compound zonary placenta. These two sets of facts led Von Jhering to conclude that all the young produced at one litter by the armadillo are the product of the fertilization of a single egg, which produced a number of embryos by the fission or subdivision of that ovum subsequent to impregnation.

New observations were made upon the development of the claws of the young armadilloes, which Von Jhering found were developed in a singular manner, obviously recapitulating some of the characteristics of the extinct forms.

The reviewer gives a synopsis of Von Jhering's arrangement of the types or principal modes of reproduction. Two great subdivisions are recognized:

[1] Biolog. Centralbl., vi. pp. 532–539 (No. 17, 1886).

[2] It is significant in this connection that when human twins are enveloped in a common chorion they are always of the same sex.

1. Hologeny. From the fertilized egg but one individual takes its rise, with or without metamorphosis. Hypogenesis (Haeckel).

2. Merogeny. From the fertilized egg two or more individuals are developed, which,—

A. Revert directly to the form and manner of reproduction of the parent. Temnogenesis.

B. Develop into individuals which become different, or a series of generations, varying in their mode of development (alternation of generations, metagenesis).

a. Calycogenesis (Salpa, Medusæ).

b. Paidogenesis (Cecidomyia).

c. Heterogenesis, in which either both generations are sexually reproduced, or one or several are reproduced parthenogenetically.

The peculiar type of reproduction called "temnogenesis" by Von Jhering, and characteristic of *Praopus hybridus*, leads to the somewhat paradoxical conclusion that the mother may become the grandmother of her own child, in virtue of the segmentation of the ovule into a number of distinct germs, which lead to the development of as many distinct individuals of the same sex. The same thing apparently occurs when in the human subject twins are invested by a common chorion. The subject, however, needs further investigation, especially since the researches of Dareste, Fol, Kleinenberg, and especially of Rauber, have so greatly extended the views of Lereboullet in respect to the mode of origin of double monsters among vertebrates or pleurogastric types. That the production of double monsters occurs among hypogastric types in essentially the same way as in the vertebrates seems to be pretty conclusively established by Mr. Ryder's observations upon double monstrosities among lobster embryos.

ANTHROPOLOGY.

Chinese Jade in America.—In the "Proceedings of the American Antiquarian Society," vol. iv. p. 62, Mr. Frederick W. Putnam makes a report of jade objects which have a double interest. Twelve specimens are reported from Nicaragua and Costa Rica, ten of which were ornaments made by cutting celts into halves, quarters, or thirds, a portion of the cutting edge of the celt remaining on each piece. The method of sawing the objects is indicated. The first query, therefore, is, For what reason should a celt of such hard material be cut up and perforated? Let us suppose that the original blade belonged to the outfit or accoutrement of a celebrated warrior, hunter, or artist. The pieces of that blade would become powerful medicine or influential fetishes and highly prized.

Greater astonishment is excited when we read the report of Mr. O. W. Huntington upon the nature and source of the material in these ornaments. It is as follows: "The specimens which you left with me are unquestionably Chinese Jade, having all the characters of that mineral, although the largest specimen from Costa Rica is rather unusual in its color, and would not be taken for jadeite at sight."

No. 33,395, Costa Rica, H. = 7. Sp. gr. on 166 grms., 3.281. A small fragment before the blow-pipe fused readily below 3 to a glassy bead.

No. 33,391, Costa Rica, H. a little under 7. Sp. gr. on 54½ grms., 3.341. Fused quietly below 3 to transparent glass, not acted on by acid.

No. 32,794, Costa Rica, H. a little under 7. Sp. gr. on 13 grms., 3.326. Fused quietly below 3 to a transparent glass, not acted on by acid.

The day has gone by for hasty conclusions, and Professor Putnam would be one of the last to jump at one. The NATURALIST will shortly give account of evidences of connection of Costa Rica with Polynesia by means of a witness in another kingdom of nature. It will now be in order to collate during the next ten years the evidence for and against contact between the Orient and the western shores of America which will speak for itself.

Ornaments on Pottery.—It is thought by some that ornamental patterns on pottery are handed down by savages from one generation to another. This is not true of our Indian, who, after making a pot, ornaments it with improvised designs. He has no pattern-books to guide him.

Indians of New Mexico accustomed to pottery-making have, since their contact with whites, given attention to more elaborate ornamentation; just as those of Mexico meet a demand and find their way into public and private collections. The most noticeable change in technique is the use of animal and human forms, which, though not unknown on older pieces, are rare.

Toy forms of pottery and those animal and human designs which met the readiest sale have been most improved by a kind of natural selection.

The thirst for antiquities has also stimulated the native artists to imitate them. In the city of Mexico an Italian made a good living for three years making stone sculptures in imitation of antiquities. The writer saw some of his works, but they were easily detected. The children all had European faces, and the delicate parts of the body were too well worked out.

Near the city of Mexico live a settlement of Indians who have the credit of manufacturing clever imitations of ancient pottery.

The noble custom of exciting in children the love of the beautiful through toys and dolls was not neglected by the ancient Mexicans. Even at our day a striking example is the manufacture of toys in great profusion at Guadalajara, which are sold not only throughout the republic but outside.

They are taken on the backs of men and animals, packed in baskets and crates. These toys are very truthful representations of the manners and customs of the people. For the rude apparatus employed they are truly remarkable. The most interesting fact about this ware is the way in which the artist holds on to ancient forms, and in the decoration yields himself absolutely to the whims and demands of the market. He even borrows from the Spaniard the art of silvering and gilding.

This almost total hiding of the old thing which they are unwilling to give up, with paint and forms to which their old art was a stranger, is also seen in their gourd vessels.

The pitchers from Toluca, once simple unnozzled vessels, are lost in the large spouts, altered handles, polished surface, elaborate decoration, glazing, and stamping.

Still one may visit regions in Mexico where the old art still survives. The Pames, near the Valle del Maiz, and the Huastecas, the Indians of Sierra Nola and of Savanito, away from the influence of innovations, make their pottery as of old, simple in form and decoration.—*Edward Palmer.*

Head-flattening.—Dr. R. W. Shufeldt, U.S.A., contributes to the *Journal of Anatomy and Physiology* a paper on the skull of a Navajo child. The most interesting feature of this skull is the marked parieto-occipital flattening. The plane is somewhat oblique, and there is not only a flattening but a gentle depression over the entire area involved. The bones flexed are the two parietals from a little in front of the obelion, and almost the whole of the supra-squamous portion of the occipital. Dr. Shufeldt has not seen a Navajo skull lacking this feature. Navajo women carry their children about strapped on a stiff cradle-board, with only a small, narrow pad beneath the occiput. However, it is only the infants of a few months of age that have their heads bound down closely to the backboard of their portable cradles. Just as soon as they are able to support their heads and have acquired sufficient strength to control the movements of this part of the body, they are at once allowed considerable more latitude in this particular. Indeed, in the case of children who range from six months, or at the most eight months, of age, and upwards, I have never observed that the Navajo mothers strap their children's heads at all. If the strapping of the head during these first few months of infant life is sufficient to produce this lasting deformity, then the problem is surely solved once for all.

Love and Anthropology.—Professor Paolo Mantegazza has published in Milan two volumes on love among the different races of men, which have been reviewed in several foreign magazines. Following his example, Dr. D. G. Brinton has laid the tender passion upon the dissecting-table, and given to the world the result of his work in a paper read before the American Philosophical Society on the 5th November, based upon one of Carl Abel's "Linguistic Essays" (London, 1882).

The key-note of Dr. Brinton's study is in his second paragraph, in which he says, "I shall give more particular attention to the history and derivation of terms of affection as furnishing illustrations of the origin and growth of those altruistic sentiments which are revealed in their strongest expression in the emotions of friendship and love.

"Upon these sentiments are based those acts which unite man to man in amicable fellowship, which bind parent to child and child to parent, which find expression in loyalty and patriotism; which, exhibited between the sexes, direct the greater part of the activity of each individual life, mould the form of social relations, and control the perpetuation of the species; and which have suggested to the purest and clearest intellects both the most exalted intellectual condition of man, and the most sublime definition of divinity."

In the Old World and in the New, Dr. Brinton finds the principal words expressing love in one of two ruling ideas, the one intimating similarity between those loving, the other a wish or desire. The former conveys the notion that the feeling is mutual, the latter that it is stronger on one side than on the other.

A third class of words of later growth combines the two sentiments into the loftiest terms of affection.

The existence of these forms of expression is traced through the Algonquin, Nahuatl, Maya, Qquichua, and Tupi-Guarani stocks with the following general results:

1. The original expression of love as revealed in the languages of those people was as follows:

1. Inarticulate cries of emotion (Cree, Maya, Qquichua).

2. Assertions of sameness or similarity (Cree, Nahuatl, Tupi, Arawack).

3. Assertions of conjunction or union (Cree, Nahuatl, Maya).

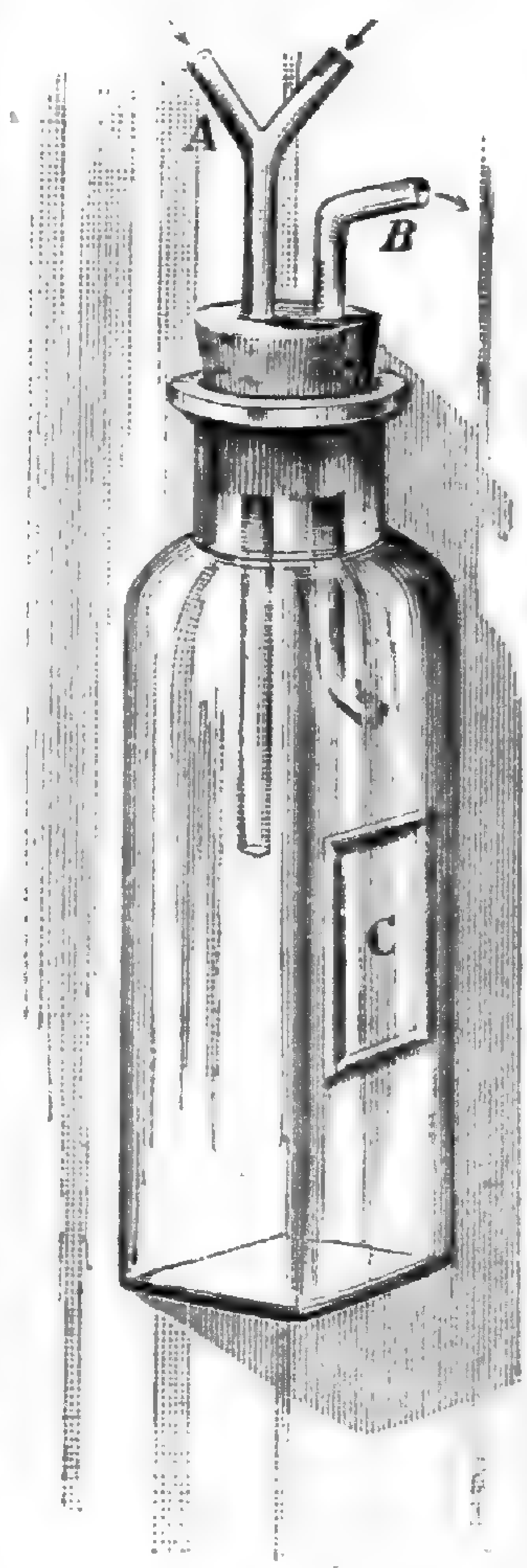
4. Assertions of a wish, desire, or longing (Cree, Cakchiquil, Qquichua, Tupi).

Loochoo, sometimes written Liuchiu, and called by the Japanese Riukiu, is the chief island of a group lying in the North Pacific Ocean between the 24th and 29th parallels of latitude, and forming a chain extending from Formosa to the southernmost extremity of Japan. The Chinese accounts state that the island of Loochoo was discovered by an exploring expedition sent out by the Emperor Yang Kwang, of the Sui dynasty (A.D. 608), which brought back to China one of the inhabitants. It was subsequently visited more than once by the Chinese, and early in the fourteenth century one of the emperors of the Ming dynasty sent some thirty Chinese families to Loochoo to civilize the natives, and teach them the arts and customs of China. Each king of Loochoo, upon his accession to the throne, sent special envoys to announce the fact to the emperor, and to ask that commissioners be sent to confer investiture upon the new king. This was always acceded to, and the reports of some of the commissioners have been published in China and Japan, which are exceedingly well written and illustrated. The king of Loochoo always used as his seal of state one conferred upon him by the Chinese emperor. He also sent envoys at stated times to bear tribute and congratulations to the emperor, who generously allowed them to bring with them a certain number of the sons of the Loochooan nobles to be educated, at the emperor's expense, in the Kwo tsi Kien, or National College, at Peking. This state of things continued until after the change in the Japanese government, in 1868, when it was put to an end by the Japanese. The Japanese first became acquainted with the Loochooans A.D. 1451, when certain Loochooans brought a present of one thousand strings of cash (or Chinese copper coins) to the ruling Shogun, and from this time the Loochooans traded frequently to Hiogo and Kagoshima. Their relations to Japan were always of a most friendly character, and their vessels came very frequently bearing presents. But, A.D. 1609, Iyehisa, prince of Satsuma, fitted out an expedition to Loochoo, captured the king, and brought him prisoner to Kagoshima. He was released at the end of three years, although the Japanese could not succeed in inducing him to abjure his allegiance to the emperor of China, yet compelling him to pay an annual tribute to the prince of Satsuma, as the Japanese histories say, and forbidding him to inform the Chinese of the fact. From this time until 1868, the Loochooans continued to pay tribute both to China and Japan. When Commodore Perry wished to insert some provisions relating to Loochoo in his treaty with the Shogun ("tycoon"), the latter was unable to accede to Perry's wish, as the Shogun had no jurisdiction, Loochoo being considered by the Japanese as a dependency of the prince of Satsuma, and Commodore Perry (and after him the Hollanders) concluded a separate convention with the king or regent of Loochoo. After the surrender, in 1871, by the Japanese feudal princes to the Mikado of their territorial powers and possessions, the Imperial government, claiming Loochoo as a former dependency of the Prince of Satsuma, commenced to introduce more and more Japanese laws and regulations into Loochoo; and finally, in 1879, notwithstanding the earnest remonstrances of the Loochooan king's envoys, who appealed for aid to the Chinese minister in Tokio, as well as to our own minister, the Hon. John A. Bingham, the Japanese dethroned the king of Loochoo, and brought him with his family to Tokio, where he now is receiving a pension from the Japanese government, who have supplanted the native Loochooan officers and laws by Japanese officials and the Japanese code, and have prohibited the Loochooans from paying tribute to China or from holding commercial intercourse with that country. The course pursued by Japan was deeply resented by China, and war between the two countries seemed for a while highly probable. Prince Kung and the viceroy Li Hung Chang requested General Grant to act as mediator, but the Japanese were unwilling to submit the case to arbitration, and the question still remains unsettled, and prevents the existence of anything like cordiality between the governments of China and Japan.—*D. Bethune McCartee, M.D.*

MICROSCOPY.[1]

Orienting Objects in Paraffine.—In the *Zool. Anz.*, No. 199, Selenka has described a method of keeping paraffine melted while the contained small objects are being arranged under the microscope in any desired position, and then of rapidly cooling the paraffine without disturbing the position of the objects.

Finding it difficult to make tubes such as he describes, which should be of such shape as to admit of removing the hardened paraffine readily, and at the same time with depressions of sufficient size for any but very minute objects, I have made use of the following simple device, which, though more clumsy than the tube of Selenka, can be used for objects 1 mm. long and much larger, while giving a block of paraffine of very regular shape and with rectangular sides.



A common flat medicine-bottle is fitted with a cork through which two tubes pass, or if the mouth is small one tube may be fastened into a hole drilled into the bottle. One of these tubes (*A*) is connected with hot and cold water; the other (*B*) is a discharge-pipe for the water entering the bottle by (*A*), and raising or lowering its temperature as warm or cold water is allowed to flow in. On the smooth flat side of the bottle four pieces of glass rods or strips are cemented fast so as to enclose a rectangular space (*C*) which forms a receptacle for the melted paraffine. As long as the warm water circulates through the bottle the paraffine remains fluid, and objects in it may be arranged under the microscope by light from above or below, and

[1] Edited by Dr. C. O. Whitman, Milwaukee.

can be oriented with reference to the sides of the paraffine-receptacle or with reference to lines drawn upon the surface of the bottle.

When the cold water is allowed to enter in place of the warm, the paraffine congeals rapidly and may be easily removed as one piece. The discharge-pipe should open near the upper surface of the bottle, to draw off any air which may accumulate there.—*E. A. Andrews.*

Orientation of Small Objects for Section-Cutting.—It is frequently a very difficult matter to properly orient small objects, especially spherical eggs, so that sections may pass through any desired plane. In my work on the embryology of the common shrimp I have found the following process very convenient. Impregnation with paraffine is accomplished in the usual way, and then the eggs (in numbers) in melted paraffine are placed in a shallow watch-crystal. They immediately sink to the bottom, and then the whole is allowed to cool. The crystal, glass upwards, is now placed on the stage of the microscope and the eggs examined under a lens. In this way one can readily see exactly how any egg lies, and then with a knife it may be cut out with the surrounding paraffine, and in such a way that it can readily be fastened to the block in any desired position. After all which have dropped in a suitable position are thus cut out, the paraffine is again melted, and after stirring the eggs the cutting out is continued as before.—*J. S. Kingsley.*

PSYCHOLOGY.

The Perception of Space by Disparate Senses.—The following is an abstract of an interesting paper by Mr. Joseph Jastrow on the nature of space conceptions, contributed to *Mind*, vol. xi. p. 539. It records the result of experiments made on different persons at the Psychophysical Laboratory of the Johns Hopkins University, Baltimore:

In order to approach the problem by experimental methods it will be necessary to define accurately such terms as sight, touch, motion. The following classification, though provisional and imperfect, will perhaps be found convenient. We can obtain the notion of extension:

I. By the stimulation of a definite portion of a sensitive surface.

(1) Of the retina (where the distance of the stimulating object must be inferred);

(2) Of the skin,

(*a*) By the application of a pair of points, leaving the intermediate skin unstimulated, or (*a*) stimulating it by the application of a straight edge;

(*b*) By the motion of a point along the skin (see *Mind*, 40 pp. 557 ff.); [(*a*) and (*b*) may be contrasted as simultaneous and successive.]

II. By the perception of distance between two movable parts of the body, *e.g.* between thumb and forefinger;

III. By the free motion of a limb, *e.g.*, the arm.

The operations to be known as reproducing judgments by the eye, the hand, and the arm are respectively,—judging lengths by fixing the eyes upon them without motion of the eyeball, a form I; judging distances between thumb and forefinger, a form of II; and judging distances by guiding a pencil over them with a free arm movement, a form of III.

The problem was to compare the judgments of linear extension made by these three senses, and to determine their relative accuracy. The method consisted in presenting a definite length to one of these senses of the subject, who was then required to adjust a second length equal to the first by the use of the same or of another sense. The judgments were confined to lengths between 5 and 120 mm. The lower limit is set by the inconvenience of seeing, drawing, and measuring such small lines; the upper by the greatest "span" between thumb and forefinger, as well as by the longest line distinctly visible without motion of the eyeball. More direct methods of testing the relative fitness of these senses and of their memory for absolute lengths were also employed. In several of the operations the two sides of the body were involved, and it became necessary to study the effect of this circumstance.

RESULTS.

In judging that a length perceived only by the eye is equal to another length perceived either by the eye, hand, or arm, there will be an error. The problem consists in tracing the nature and extent of this error.

I. When the receiving and expressing senses are the same.

(1) If the eye is both receiving and expressing sense, small lengths will be underestimated, and large lengths exaggerated, the point at which no error is made being at about 38 mm.;

(2) If the hand is both receiving and expressing sense, small lengths will be exaggerated, and large lengths underestimated, the indifference point being at about 50 mm.;

(3) If the arm is both receiving and expressing sense, all lengths (within the limits of the experiments) will be exaggerated.

The conclusions above discussed may be summarized thus:

When the same acts as the receiving and the expressing sense, the error is small (and the process easy). In operations involving the use of both sides of the body, an interchange of the function of the two sides reverses the results; when one hand alone is used in successive judgments, no such reversal takes place. The preferred hand in span-sensations is the right; the preferred arm in motion, the left. The error of the eye is less than that of the hand; the error of the hand slightly less than that of the arm.

II. When the receiving and expressing senses are different.

(1) If the eye is the expressing sense, and (*a*) the hand the receiving sense,

All lengths are greatly underestimated, the error decreasing as the length increases.

If the eye is the expressing sense, and (*b*) the arm the receiving sense,

All lengths are greatly underestimated, the error decreasing as the length increases. By combining the two conclusions we see that,—

If the eye is the expressing sense, all lengths are greatly underestimated, the error decreasing as the length increases.

(2) If the hand is the expressing sense, and (*a*) the eye the receiving sense,

All lengths are greatly exaggerated, the error decreasing as the length increases.

If the hand is the expressing sense, and (*b*) the arm the receiving sense,

All lengths are greatly exaggerated, the error decreasing as the length increases.

If the hand is the expressing sense, all lengths are greatly exaggerated, the error decreasing as the length increases.

(3) If the arm is the expressing sense, and (*a*) the eye the receiving sense,

All lengths are greatly exaggerated, the error decreasing as the length increases.

If the arm is the expressing sense, and (*b*) the hand the receiving sense,

All lengths are greatly underestimated, the error decreasing as the length increases.

A. The error decreases as the length (to be reproduced) increases.

This means that (within the limits of the lengths experimented upon) a larger length is reproduced more accurately than a smaller one.

B. If reproducing one sense by another results in an exaggeration (or underestimation), then reproducing the second sense by the first will result in an underestimation (or exaggeration) to about the same extent.

C. A third rather peculiar law remains to be noticed. The processes involved in the above-described experiments can be represented thus: A length presented to the receiving sense makes a certain impression on my brain-centre; the problem, then, is to reproduce the objective stimulation, which shall give me an equivalent sensation. The two operations being simultaneous, the sensations can be compared and the judgments corrected until they agree. When the receiving and expressing senses are the same, the comparison is between homogeneous sensations, involving one brain-centre; the operation is easy and the error small. When the expressing sense differs from the receiving sense, heterogeneous sensations must be compared, involving two brain-centres,—a difficult operation with a large error. The large error seems to be due to a looseness of association between heterogeneous space-centres; it is a path of high resistance. Why this error is in the direction in which it is, and not in the opposite direction, depends on some fundamental relation of the senses involved, still to be discovered. For the present the fact that the same objective spacial stimulation has a different value for the several space-senses is to be emphasized. Our conclusions, then, are (1) that the memory for absolute measurements is not quite accurate, the order of accuracy being sight, span, motion; (2) that the operation probably consists in matching the reproduction with the homogeneous mental recollection; (3) that the visual inch is too short, the span- and motion-inch too long. These conclusions evidently favor the point of view of law C.

D. Finally, a comparison of the error in reproducing by the same and by a different sense leads to the very important conclusion that the former operation is an accurate and easy one, the latter an inaccurate and difficult one. The difficulty manifests itself as a feeling of discomforting uncertainty and lack of confidence in one's judgments, and a great susceptibility of fatigue. The connection between senses seems to be a loose one.

SCIENTIFIC NEWS.

— Engelmann, of Leipzig, announces a continuation of the well-known Bibliotheca Zoologica of Carus and Engelmann, bringing the work down to 1880. The former work contained a catalogue of the literature of zoology from 1846 to 1860, and was itself a continuation of Agassiz's Bibliographia Zoologiæ et Geologiæ, which contained the works previous to the earlier date. The establishment of the *Zoologischer Anzeiger* in 1878 furnished a regular record for zoological literature, and hence this continuation of the Bibliotheca fills in the gap between the *Anzeiger* and the Bibliotheca of Carus and Engelmann, and thus places in the hands of zoologists a complete list of works on zoology. This continuation will be edited by Dr. Taschenberg, of Halle, and will make about twelve parts of three hundred and twenty pages each, and is issued at a price of seven marks per part.

— Gustav Haller, a student of the mites, died May 1, 1886, at Berne.

— George Busk, a well-known English zoologist, whose writings on the Polyzoa and Hydrozoa are standards, died in London, August 10, 1886, in his seventy-eighth year.

— Students of the Coleoptera will miss Maurice Girard, a French entomologist, who died in August, 1886, aged sixty-four; and even more Baron Edgar von Harold, who, with Gemminger, compiled a most valuable catalogue of the Coleoptera of the world. He died in Munich, August 1, 1886.

— Dr. A. C. Oudemans, of Utrecht, has been made director of the Zoological Gardens at the Hague. His place as conservator of the Zoological Museum of Utrecht has been filled by C. H. van Herwerden.

— Karl Plötz, a student of the Lepidoptera, died at Greifswald, August 12, 1886, aged seventy-three.

— H. C. Weinkauf, a conchologist, died at Kreuznach, August 14, 1886.

— Professor A. Hyatt's "Larval Theory of the Origin of Tissues" has been translated into Pelletan's *Journal de Micrographie.*

— Dr. Alois von Alth, the mineralogist and palæontologist of Cracow, died November 5, 1886. He was professor of mineralogy in the University of Cracow.

— Professor L. Dieulafait, professor of geology at Marseilles, died recently. Dr. Depéret, of Lyons, has received a call to fill the chair thus left vacant.

— Mr. Edward J. Miers, the eminent student of Crustacea, has been forced by continued ill health to resign his position as assistant in the British Museum.

— To the French desire for conquest and colonization is to be attributed the death of the celebrated physiologist Paul Bert. He was born at Auxerre, France, October 17, 1833. In 1867 he became a "docent" at Bordeaux, and in 1875 he received the grand prize of the French Academy, amounting to four thousand dollars. In 1878 he became president of the Biological Society of France, and in 1882 was made a member of the Academy of Sciences. He held various political offices, and exhibited such administrative ability that he was appointed governor of the newly-conquered province of Tonkin. He died at Hanoi, November 11, 1886.

— A new *Centralblatt für Bacteriologie und Parasitenkunde* is announced from the publishing house of Gustav Fischer, Jena.

It is to be issued in weekly numbers at an annual cost of twenty-eight marks, and is to concern itself with the phenomena of vegetable and animal parasitism in the widest sense. Dr. Oscar Uhlworm, Cassel, is the editor, Professor Leuckart and Dr. Loeffler being associated with him. Professor R. Ramsay Wright, Toronto, has undertaken to furnish a report to the new journal of papers published on this continent referring to animal parasites, and will be obliged to authors for extras of such papers.

— At the last meeting of the Regents of the Smithsonian Institution a number of changes were introduced into its organization. Professor Samuel Langley, of Alleghany, Pa., was elected assistant secretary, and Mr. G. Brown Goode was made second assistant secretary. These appointments open up a long future of prosperity to the institution, other things being equal.

— It is not generally known that it is to the late General John A. Logan that the United States owes its Geological Survey. He introduced and had passed the first bill for this object, and Dr. F. V. Hayden was sent, under its provisions, to Nebraska, the field of its first operations.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Indiana Academy of Science.—The second annual meeting of the Indiana Academy of Science was held in the court-house at Indianapolis, December 29 and 30, 1886. The sessions were presided over by the president, Professor D. S. Jordan. Twenty-five new members were elected after their applications had passed through the hands of the nominating committee. The Academy was called to order at ten o'clock A.M., December 29, and opened with prayer by Rev. A. R. Benton. J. C. Branner, S. Coulter, and P. S. Baker were appointed a committee to nominate officers for the next year. J. P. D. John, J. M. Coulter, and O. P. Hay were appointed a committee to consider applications for membership. Following the business of the morning the papers here enumerated were taken up. "Origin of the Indiana Flora," by J. M. Coulter; "The Mildews of Indiana," by J. N. Rose; "The Chlorophyll Bands of Spirogyra," by S. Coulter; "Outline of a Course in Science Study based on Evolution," by Lillie J. Martin; "The Moss Leaf," by C. R. Barnes; "Additions to the Flora of Jefferson County, Ind.," by George C. Hubbard; "Our Blind Mice," by E. R. Quick; "Notes on the House-Building Habits of the Muskrat," by Amos W. Butler; "A Curious Habit of the Red-headed Woodpecker," by O. P. Hay; "Notes on Indiana Ornithology," by A. W. Butler; "The Work of the A. O. U. Committee on Bird Migration," by B. W. Evermann; "The Higher Classification of the Amphibia," by O. P. Hay; "Some Reptiles and Amphibians that appear to be Rare in Indiana," by O. P. Hay; "Some Reptiles and Amphibians that are to be looked for in Indiana," by O. P. Hay; "Notes on the Winter Habits of Amblystoma tigrinum and A. microstoma," by O. P. Hay. The following papers were on the programme for the afternoon: "Notes on Birds observed in Carroll County, Ind.," by B. W. Evermann; "Review of Diplodus and Lagodon," by C. H. Eigenmann and Elizabeth G. Hughes; "Review of the American Chætodontidæ," by C. H. Eigenmann and Jennie Horning; "The Fishes of the Wabash and some of its Tributaries," by O. P. Jenkins; "The Relation of Latitude to the Number of Vertebræ in Fishes," by D. S. Jordan; "Elagatis pinnulatis at the East End of Long Island Sound," by S. E. Meek; "Ospradium in Crepidula," by H. L. Osborn; "Notes on the Acrididæ of Bloomington, Ind., with Descriptions of Four New Species," by C. H. Bollman; "A Remarkable Case of Longevity in the Longicorn Beetle, Eburia quadrigeminata Say," by Jerome McNeill; "Some Biological Studies of Lixus macer Say, and L. concavus L.," by F. M. Webster; "Descriptions of Four New Species of Myriapods from the United States," by Jerome McNeil; "New North American Myriapods, chiefly from Bloomington, Ind.," by C. H. Bollman; "The Teaching of Entomology in the High Schools," by Jerome McNeill; "The Geodetic Survey in Indiana," by J. L. Campbell; "Recent Progress in Seismology," by T. C. Mendenhall; "An Indiana Earthquake," by J. C. Branner. At night President Jordan delivered his address on "The Dispersion of Fresh-Water Fishes."

Thursday the following papers were presented: "On the Oxidation of Para-xylene Sulphamide by Potassium Ferricyanide," by W. A. Noyes and Charles Walker; "The Scientific Study of Psychic Phenomena," by H. W. Wiley; "Causes of the Variation of Sucrose in Sorghum," by H. W. Wiley; "Preliminary Location of a Parting in the Subcarboniferous in Monroe County, Ind.," by J. H. Means and J. C. Branner; "The Limit of the Drift in Kentucky and Indiana," by J. C. Branner; "The Deep Well at Bloomington, Ind.," by J. C. Branner; "Town Geology—What it is and What it Might be," by V. C. Alderson; "On the Thysanura," by R. F. Hight; "Natural Gas and Petroleum," by A. J. Phinney; "The Geology of Vigo County, Ind.," by J. T. Scovell; "The Niagara River," by J. T. Scovell; "The Zone of Minor Planets," by Daniel Kirkwood; "The Bearing of the Lebanon Beds on Evolution," by D. W. Dennis; "The Surface Geology of the Wabash-Erie Divide," by C. R. Dyer; "Zoantharia rugosa," by A. J. Phinney; "The Physical Geography of Decatur County, Ind., during the Niagara Period," by W. P. Shannon; "The Estimation of the Carbonic Acid in the Air," by T. C. Van Nuys and B. F. Adams; "The New Alkaloid, Cocaine," by P. S. Baker; "The Nation—the Subject Matter of Political Science," by A. B. Woodford; "The Manner of the Deposit of the Glacial Drift, and the Formation of Lakes," by O. P. Hay.

The following officers were elected for the next year: President, John M. Coulter; Vice-Presidents, J. P. D. John, J. C. Branner, T. C. Mendenhall; Secretary, Amos W. Butler; Treasurer, O. P. Jenkins.

The Academy will hold its spring meeting May 19 and 20, at a place to be selected by the Executive Board. C. R. Barnes and B. W. Evermann were selected to arrange the programmes for the meetings of 1887.

Boston Society of Natural History, 1886.—December 1.—Mr. S. R. Bartlett reviewed Ranvier's anatomical studies of some Mammalian Salivary Glands, and Professor W. T. Sedgwick spoke of the Contractile Vacuoles of Paramœcium, etc. Mr. W. L. Harris exhibited some rare (living) Amblystomas, and an aberrant form of the Newt.

December 15.—Dr. Edward G. Gardiner reviewed recent researches on a Third (rudimentary) Eye in Lizards, and Professor W. M. Davis discussed the Mechanical Origin of the Triassic Monoclinal in the Connecticut Valley. The Section of Entomology met on Wednesday evening, December 22.

New York Academy of Sciences.—Monday evening, December 6, 1886.—Mr. Seth E. Meek presented a paper entitled "The Fishes of Cayuga Lake."

December 13.—A series of a hundred lantern views, illustrative of the paper lately read before the Academy upon the subject of Earthquakes, were exhibited by Dr. J. S. Newberry.

Biological Society of Washington.—Saturday evening, October 16, 1886.—The following communications were read: Mr. F. H. Knowlton, "Fascination in Ranunculus and Rudbeckia;" Mr. J. B. Smith, "A Novel Form of Insect Invasion;" Mr. F. W. True, "A Revision of the Genus Lagenorhynchus."

November 27.—The following communications were made: Mr. William H. Seaman, "Notes on Marsilia quadrifolia (illustrated)." Mr. P. L. Jouy, "Observations made during a Journey through Corea." Mr. Lester F. Ward, "Autumnal Hues of the Columbian Flora." Dr. C. Hart Merriam, "Contributions to North American Mammalogy. Description of a New Species of Bat."

December 11.—The following communications were made: Dr. Theobald Smith, "Parasitic Bacteria and their Relation to Saprophytes." Mr. F. A. Lucas, "On the Osteology of the Spotted Tinamou, Nothura maculosa." Mr. C. D .Walcott, "Tracks found on Strata of Upper Cambrian (Potsdam) Age." Dr. Frank

Baker, "The Foramen of Magendie." Dr. C. Hart Merriam, "Contributions to North American Mammalogy. Description of a New Sub-species of Pocket-Gopher."

Appalachian Mountain Club.—Special meeting, Thursday evening, December 16, 1886.—A semi-social meeting was held from 7.30 to 10.30. Photographs were on the tables for examination. During the evening a paper entitled "A Trip to Norway and the North Cape" was presented by Miss Marion Talbot. Lantern views of Norwegian scenery were shown. Rev. John Worcester showed lantern views of scenery on the Presidential Range, north of Washington.

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MORE ABOUT THE SEA-HORSE.

BY SAMUEL LOCKWOOD.

THE July number of the AMERICAN NATURALIST for 1867 contains my article, "The Sea-Horse and its Young." Although the result of a long study of living specimens of this eccentric fish, yet some questions remained unanswered. At the time mentioned I was living at Keyport, on Raritan Bay. Early in 1870 my residence was changed to Freehold, fourteen miles inland, hence it has happened that specimens sent me have succumbed before reaching my home. A happy exception occurred November 1, 1884, in the arrival from Shark River of a fine large female *Hippocampus heptagonus* Rafin. As the subject of my article in 1867 was a male, I prized my new pet highly.

With an aquarium devoted entirely to this specimen, I set about studying her peculiarities. She had the same habit of converting her tail into a prehensile organ, and so would coil the tip around a tuft of sea-lettuce, and with the pretty dorsal fin in movement like an undulating ribbon, would sway to and fro, keeping the body erect. The sight of the sea-horse alive in the water is always pretty, although quite grotesque, for its action differs so greatly from that of other fishes, which are prone, and usually move in a line parallel to the bed of the water, while, as a child would express it, the sea-horse swims standing up on its tail. The crested head is erect,—the action though stiff is graceful, not unlike the knightly steeds on the chess-board, very quaint yet comely.

I had through all those years desired to see the giving of the spawn by the female and the taking of it by the male; for, as shown in that article of 1867, the male Hippo is not only father but nurse to the young. In his front, just a little higher than the vent, is a sac, into which he receives the eggs of the female, and in which he hatches them. My desire was to see the method of taking the eggs into this pouch. Did he put them in or did she? Despairing now of ever seeing them in apposition, I must describe the act as I think it does take place.

I cannot believe that the twain are without emotion, since it is true of some of the higher fishes that the love-season calls out their intelligence to its highest manifestation. Suppose in our latitude it is July. A pair of these Hippocampi meet. They curl their prehensile tails about each other and assume an erect position, face to face. The female emits her eggs in a slow stream immediately over the pouch, which opens and closes at the top. The motion of the mouth of this sac is that of suction, thus the eggs are actually drawn into it. There they are patiently hatched and also nourished, as shown in the paper referred to. This apposition of the sexes, to be sure, is hypothesis, yet I think it will prove to be true. At any rate it is the outcome of long and patient thought, and is perfectly consistent with observation of habit.

When the young are ready for eviction, the pouch, which on receiving the eggs was fat and thick, has become flaccid and thin. Its adipose lining has been absorbed by the young fishes. So badly wasted is the pouch that muscular action sufficient to expel the brood is impossible. The father-fish evicts his charge in the following way. He gets himself in an erect position alongside of some object, a stick, stone, shell, or plant, either hooking the end of his tail under it, or in some way getting hold by its prehensile tip. Then stiffening the whole body and keeping it erect, he leans upon the object and brings himself down against it with a jerky movement; this rubs up the pouch, pushing out some of its occupants. This is done repeatedly until the whole brood is forced into the water.

Now, it is observable that an anal fin would be greatly in the way during such an operation. In fact, it would be a very bad obstruction. Hence the absence of this fin in the male Hippocampus. But it is present in my female, for in her case it is not in the way. In fact, it may be that she utilizes it at the time of emitting her spawn, as she could produce a gentle eddy of the water in the direction of the male's pouch.

I found by the microscope that diatoms were being generated in the tank, and I fancied that my pet was feeding on them, for in all my devices I did not succeed in feeding her myself. She would show a movement in her tubular snout which looked like sucking something in. Sometimes she would stretch herself on the bottom of the tank and apply the tip of her nozzle in a way that seemed to me like selecting by sight. And what a cunning look! as with sacerdotal steadfastness of purpose one eye was turned towards heaven and the other kept upon the earth. Certainly her food was microscopic, and in the hunt her optical application was binocular or monocular at will.

I noticed with some concern that the peculiar scales which covered its body, and looked not unlike plate armor, were becoming green. It proved that a growth of micrococci had set in, and was rapidly spreading over her. I was quite solicitous about it; for it would hardly do for me to clean it, so tender is the little creature. Its tank had become badly infested with these unicelled algæ. For the purpose of keeping up a supply of microscopic life for its food, besides the little two-gallon aquarium, I kept two specie jars going, and would transfer it to them, so that it could have freshness of food. Deciding to clean up the aquarium, I put it in one of the jars. It quite enjoyed the change, and to my surprise performed a series of movements on the clean sand, which turned out to be successful efforts to scour off the green parasitical slime. It needed patience, but that, with perseverance, did the work.

She was in a few days put back into her aquarium. The little handling necessary always begat a discernible clucking as of terror. It was really a species of snapping of the lips of the tubular snout. I heard it often, and under different circumstances, and thought I could detect three intonings,—one which was excited by terror, one denoting a pleasurable emotion, as when in play, and a third when quite still, perhaps faintly like the purring of another pet. But perhaps my intense sympathy with the little creature may give color to these interpretations.

Alas, there was now too much ground for sympathy,—a terrible malady had begun to take hold of the poor thing. The face took on a comical aspect. On each side rose a swelling as if she had the mumps. With a hand-lens I found that these were blisters, white vesicles, and so buoyant as to annoy her by producing eccentric movements. I contrived to pierce them with a needle, and so to let out the confined gas. This gave immediate relief. But they came again, and by and by my surgery did not avail. They increased, and the buoyancy would raise it to the surface, and the little sufferer despite all help would float. And so it was on the last day of February at an early hour I found poor Hippie afloat on her beam ends and dead. I had her alive just four months, and the above is but a tithe of what might be told of her pretty ways.

THE TACONIC QUESTION RESTATED.

BY T. STERRY HUNT.

§ 1. So much obscurity and misconception still exist in the minds of most geologists regarding what have been called the Taconic rocks, that it seems desirable to set forth clearly, and more concisely than has yet been done, the principal facts in the history of the two wholly distinct and very unlike groups of strata which have hitherto been included under this title, and which occupy very important places in American stratigraphy as well as in economic mineralogy. For a clear understanding of these strata, which, as originally described, lie between the crystalline schists of western New England and the continuous area of rocks belonging to the Ordovician (Chazy-Loraine) period, found along the Hudson and Çhamplain valleys, we must go back to the writings of Amos Eaton, in which we find, as early as 1832, a concise but complete exposition of the great stratigraphical problems presented by the region in question. The gneisses, with hornblendic and micaceous schists, of the Atlantic belt were then regarded by Eaton as the slaty or argillaceous member, constituting the lowest division, of his triple series of Primitive rocks; and were declared by him to be there followed by the second or silicious, and the third or calcareous member of the same series. These were the Granular Quartz-rock and the Granular Lime-rock, by which names he designated the quartzite and the crystalline limestone of the Taconic (or Taghkonic) Hills in western New England.

§ 2. Above the Primitive, Eaton placed the Transition series, including, like the last, three divisions: First, at the base, a schistose or so-called argillaceous member, named by him the Transition Argillite, and representing in this second series the gneisses and crystalline schists of the Primitive. Second, a silicious member, consisting of a great group chiefly of sandstones and conglomerates, comprehensively described by him as millstone-grit, rubble, and graywacke-slate, the whole representing in the Transition series the Quartz-rock of the Primitive, and called the First Graywacke or Transition Graywacke, a term borrowed from German geologists. Third, a limestone named by him the Sparry Lime-rock, and representing in this series the Granular Lime-rock of the Primitive. Eaton insisted upon the existence of a stratigraphical break, and a discordance, between the Transition Argillite and the overlying Transition Graywacke, the distribution of which latter was described in detail. It was said to be "seen resting on the Argillite in Rensselaer County, where its subdivisions form a ridge which extends from Canada through the State of Vermont, and Washington, Rensselaer, and Columbia Counties in New York." The conglomerates of this Transition Graywacke were further said to make "the highest ridges between the Massachusetts line and the Hudson."

§ 3. To the west of Lake Champlain, along the base of the Macomb Mountains (since called the Adirondacks), and resting upon the Primitive gneiss, Eaton found what he called the Calciferous Sand-rock (a magnesian limestone, sometimes holding gypsum), which he declared to be the equivalent, in this region, of the Sparry Lime-rock, and to constitute, with its overlying Metalliferous Lime-rock (a term borrowed from Bakewell), the third or calcareous division of the Transition series. The sandstone since known as the Potsdam, which is often wanting at the base of the fossiliferous limestones in this region, was apparently unknown to him. It is here to be noted that Eaton, unlike many of his successors, did not confound these limestones, nor their stratigraphical equivalent to the east of the Hudson—the Sparry Lime-rock—with the crystalline limestone of Western Massachusetts, but recognized the fact that this, the Primitive Lime-rock, together with the Primitive Quartz-rock and the Transition Argillite, and the great Transition Graywacke, were all alike wanting in the Adirondack region between the gneisses, constituting the lowest member of the Primitive, and the fossiliferous limestones, the highest member of the Transition series.

§ 4. Above this last he recognized a third, or Lower Secondary series, having, like the others, for its inferior member an Argillite or Graywacke-slate, and for its second or silicious member a sandstone and conglomerate. These two members were by Eaton united under the name of the Second Graywacke, which he declared to be lithologically very much like the First or Transition Graywacke, but distinguishable therefrom by the fact that it is above instead of below the Transition limestones, and is, moreover, overlaid, in its turn, by the Lower Secondary limestones. These comprised the Geodiferous Lime-rock and the Corniferous or Cherty Lime-rock, with its included layers of what he called "stratified horn-rock," in which two subdivisions we at once recognize the Niagara and Upper Helderberg limestones of James Hall. In each of these triple series Eaton recognized, in ascending order, an argillaceous or schistose, a silicious, and a calcareous member.

All of the above details of his classification may be gathered from Eaton's "Geological and Agricultural Survey of the Erie Canal" (1824), and in the second edition of his "Geological Textbook" (1832). They were set forth by the present writer, in 1878, in his volume on Azoic Rocks ("Report E of Second Geological Survey of Pennsylvania"); and more fully, with a tabular view, in an essay on "The Taconic Question," in the first and second volumes of the "Transactions of the Royal Society of Canada," in 1883 and 1884, which is reprinted, with considerable additions, in his "Mineral Physiology and Physiography" (pages 517–686) in 1886. The student who follows the painful history of the half-century of controversy which has been required to bring order out of the confusion in which his immediate successors involved this great problem of American geognosy, can only regard with reverence the wonderful insight by which Amos Eaton was enabled, at this early period, to comprehend the complex stratigraphy of the Hudson and Champlain valleys and the western slope of the Atlantic belt.

§ 5. When, a few years later, in 1837, a systematic geological survey of the State of New York was begun, W. W. Mather was charged with the Southern district, including the region east of the Hudson, while to Ebenezer Emmons, a pupil of Eaton, was given the Northern district, to the west of Lake Champlain; Conrad, and after him Lardner Vanuxem, having the Central or intermediate district, including the counties of Oswego, Oneida, Herkimer, and Montgomery, and extending southeastward along the valley of the Mohawk to the Southern district.

Along the base of the Adirondacks, Emmons now found, in some parts, between the Transition Lime-rock of Eaton and the underlying Primitive crystalline schists, a granular or compact quartzite, which he called the Potsdam sandstone. For the rest, he did no more than confirm the determinations of his master, retaining the Birdseye or Encrinal Lime-rock of the latter as a subdivision of the Metalliferous Lime-rock, to the upper and lower portions of which he gave the names of Trenton and Chazy; while in the succeeding Second Graywacke he recognized as subdivisions, the Utica slate, the Loraine shale, the Gray or Oneida, and the Red or Medina sandstone, all of which, with the inclusion of the Potsdam sandstone, he called the Champlain division of the New York system. The last two members of this were, however, subsequently joined to what was called the Ontario division of the same system.

§ 6. The metamorphic hypothesis was then in fashion with some American geologists, and had already been applied by Nuttall, as early as 1822, to the rocks of Southeastern New York, the gneisses and crystalline limestones of which he supposed to have been formed by a subsequent alteration of portions of the adjacent graywacke and fossiliferous limestones. Mather, in extension of this notion, conjectured that the Primitive Quartz-rock, the Primitive Lime-rock, and the Transition Argillite of Eaton might, in like manner, be the results of an alteration of the members of the Champlain division of Emmons, excluding the upper sandstones; and in his final Report in 1843, on the Geology of the Southern district of New York, further maintained that not only the divisions of Eaton just mentioned, but the crystalline rocks in that State lying to the south and east of the Highland range, comprising Westchester and New York Counties, and embracing Manhattan Island, like the similar rocks of western New England, were "nothing more than the rocks of the Champlain division, modified greatly by metamorphic agencies and by the intrusion of granitic and trappean aggregates." The passage between the unaltered and the altered rocks was supposed to offer a gradual transition, and it was asserted that "no well-marked line of distinction can be drawn, as they blend into each other by insensible degrees of difference," or what have since been called successive "grades of metamorphism." These same notions were soon afterwards adopted by Logan for the crystalline rocks of the Atlantic belt in Canada, and for a time were extended by H. D. and W. B. Rogers to the gneisses and crystalline schists of the White Mountains.

§ 7. A similar view was also adopted for Pennsylvania by H. D. Rogers, then engaged in a geological survey of that State, who maintained with Mather that the Primitive Quartz-rock, the Primitive Lime-rock, and the Transition Argillite of Eaton, which are prolonged into Pennsylvania, were but the altered representatives of the Potsdam sandstone with the succeeding limestones and the Utica slate and Loraine shale of the Adirondack region. These silicious, calcareous, and argillaceous groups were named by him respectively the Primal, Auroral, and Matinal divisions of the palæozoic series, and were also called Nos. I., II., and III. in his notation. These he supposed to appear in a more or less metamorphosed and crystalline condition in the southeastern part of Pennsylvania; while farther westward in the State they occur in their unchanged fossiliferous condition, as in the Adirondack region, and are there conformably overlaid by the Oneida and Medina sandstones, which constitute together the Levant division, or No. IV. in the nomenclature of H. D. Rogers.

§ 8. The First Graywacke of Eaton, which in Eastern New York overlies the Transition Argillite, regarded by Mather as the altered representative of the Utica slate, was supposed by him to be the succeeding Loraine, Oneida, and Medina subdivisions. He thus denied the distinctness of the great belt which Eaton had traced from Canada, through Vermont, along the line between Massachusetts and New York, and confounded it with the lithologically similar Second Graywacke.

The areas of this First Graywacke, which in the southeastern part of Pennsylvania occur above the so-called "altered Auroral and Matinal," but below the horizon of the typical Levant or Oneida sandstone, were supposed by H. D. Rogers to be a part of the Matinal, and were thus virtually made a part of the Second Graywacke. It is not too much to say that this denial by Mather of the existence of the First or Transition Graywacke, and the confounding of the great belt of this (which stretches from the lower St. Lawrence to the Susquehanna, and beyond) with the Second Graywacke, was a great and fatal error in the stratigraphy of the whole region, from the consequences of which American geology has not yet escaped. It was, however, a legitimate consequence of the hypothesis of regional metamorphism applied by Mather to the great underlying series consisting, in descending order, of the Transition Argillite, the Primitive Limerock, and the Primitive Quartz-rock of Eaton, and of his attempt to identify these with the members of the Champlain division.

§ 9. Rocks belonging to the Second Graywacke are indeed found upon the banks of the Hudson River, and Mather had already, in his fourth annual report, given the name of Hudson slates to what he rightly regarded as the equivalent of those named Loraine shale by Emmons, and Pulaski shales by Vanuxem, in their respective districts. The latter, however, noticed in the Central district of New York besides these shales (which, in its northwest portion, are directly overlaid by the Gray or Oneida sandstone) an underlying series of greenish argillites and sandstones, including some graptolitic shales, but destitute of the fauna of the upper division. The lower, named by him the Frankfort division, appear in the southeast part of the district without the overlying Pulaski or Loraine division, the two being, according to Vanuxem, "not co-extensive with each other," and so distinct that he insisted on treating them separately, inclining to the opinion that they ought not to be put together in local geology. He further declared that they are separate in Pennsylvania, the characteristic Pulaski shales appearing in the Nippenose valley west of the Susquehanna, while the Frankfort slates and sandstones are seen to the east of the North Mountain in the Kittatinny or Appalachian valley, and include the roofing-slates of the Delaware. These rocks in the latter region are, in fact, the Transition Argillite and the First Graywacke, which latter is there seen, in some localities, resting upon the roofing-slates, though in many others, in the absence of this First Graywacke, the same Argillite is directly overlaid by the Levant sandstone of the Second Graywacke.

Vanuxem, having in view the contradiction between the opinions of Eaton and Emmons on the one hand and those of Mather on the other, suggested that to the lower or Frankfort division might belong the thick masses of strata "of controverted age" along the Hudson valley. Notwithstanding the evidence put forward by him as to the distinctness of these two divisions, Vanuxem, apparently for the purpose of avoiding controversy, included both the Frankfort and the Pulaski divisions under the collective name of the "Hudson River group." That these two divisions were, moreover, supposed by him to be associated with a still older series lithologically resembling them appears from his language when he wrote of "the difficulty of separating or distinguishing the slaty and schistose members of the Hudson River group from those of greater age with which, along their eastern border, the two [divisions] are more or less, really or apparently, blended." In fact, as appears from the observations of Vanuxem in Pennsylvania, and as will be further shown elsewhere, the Hudson River group of Vanuxem included alike the Transition Argillite, the First Graywacke, and portions of the Second Graywacke. The subsequent palæontological studies of James Hall in New York for many years, however, had chiefly to do with the uppermost division of this heterogeneous assemblage, and hence the name of Hudson River group has come to be very generally regarded as synonymous with Loraine shales.

§ 10. Meanwhile, Emmons came forward as the champion of the views of Eaton, and while his field of official labor did not extend to the regions occupied by the rocks now in question, declared in his final Report on the Geology of the Northern District of New York, that some account of them was necessary to a correct understanding of the relations of the Champlain division. A curious contradiction is, however, apparent in the volume in question, in certain parts of which the views of Mather are set forth, while in others Emmons remains faithful to the teachings of his master, which he ever afterwards followed. As regards the great belt called by Eaton the First Graywacke, we find, in the account of the Champlain division, described as belonging to the Pulaski or Loraine horizon, the belt of red and purple slates with red sandstones extending "through the higher parts of Columbia, Rensselaer, and Washington Counties" in New York, "and onward through Vermont into Canada." Again, we are told that portions of this same belt belong to the Loraine subdivision and the succeeding Gray sandstone, and that these last rocks are represented by the sandstones of Burlington and Colchester, Vermont, and also by those used in the fortifications of the city of Quebec. This whole Graywacke belt, as traced out by Eaton, is thus here referred, in accordance with the view of Mather, to the horizon of the Second Graywacke.

In another place in this same volume we find a discussion of the relations of the Transition or Sparry Lime-rock of Eaton to the Primitive Lime-rock, which in some sections apparently overlies it to the eastward, in which it is suggested that the latter may be younger rather than older than the Sparry Lime-rock.[1] This argument has lately been cited by J. D. Dana against the views maintained by Emmons in other chapters of the same volume, in which are set forth the teachings of Eaton that the Primitive Quartz-rock, the Primitive Lime-rock, and the Transition Argillite are, contrary to the hypothesis of Mather, inferior not only to the Trenton limestone, but to the whole New York palæozoic system, and are, moreover, directly overlaid by the Graywacke series in question, which is in turn succeeded by the Sparry Lime-rock. The whole of these, from the base of the Primitive Quartz-rock, are described in detail by Emmons in his volume of 1842, in chapters vii., viii., and ix., as belonging to a distinct system, for which the name of the Taconic system was then proposed. This Report of Emmons can thus be quoted against himself, as has been done by his opponents, for the passages already cited, which are introduced in other parts of the same volume, set forth the wholly opposed views of Mather as to the rocks in question. The secret history of these curious contradictions in this officially published Report on the Geology of the Northern District of New York, and of the persistent war waged alike against Ebenezer Emmons and his views and those of Amos Eaton, has yet to be written.

§ 11. These perplexing discrepancies and contradictions in the volume of 1842 were mentioned by the present writer in 1878 ("Azoic Rocks," p. 57) as probably due to want of method and to a change of views in the preparation of the work. In 1885 the dis-

[1] See for the preceding references the "Geology of the Northern or Second District of New York," by E. Emmons, 1842, pp. 121, 124, 125, 280–282, and further, p. 147.

cordances were again noticed,[1] when it was said of the volume, that Emmons therein "showed a divided opinion as to the horizon of the First Graywacke." This might be supposed to indicate the acceptance, for a time, of the views of Mather before finally adopting those of his old master, Eaton. It will, however, be noted that the passages, four or five pages in all, found intercalated in different parts of his account of the New York System, inculcating the doctrines of Mather,[2] are in complete opposition alike to the whole teaching in the three chapters—vii., viii., and ix. (pp. 135–164)—given to the Taconic System, and to his extended monograph thereon, published in 1844, so that one is led as an explanation of this strange contradiction to suppose that the passages in question may be interpolations by another hand. There is a painful resemblance in many respects between the story of Emmons and his opponents[3] and that of the warfare waged against Sedgwick by Murchison and his allies in the famous Cambrian and Silurian controversy, as set forth by the present writer in 1874 in his "Chemical and Geological Essays" (pp. 364, 365).

§ 12. The Taconic system, in the chapters just mentioned of this report of 1842, was said to include, in ascending order, the "Granular quartz" (or Primitive Quartz-rock), the "Stockbridge limestone" (or Primitive Lime-rock), and the "Magnesian slate." This latter, the Transition Argillite, comprehended, besides the characteristic roofing-slate, a great mass of soft and more or less schistose rocks, which, from the prevalence in them of hydrous micas (and occasionally of chlorites), have an unctuous character,

[1] Mineral Physiology and Physiography, pp. 522, 583, 584, 587.

[2] Loc. cit., pp. 121, 124, 125, 147, 279, 282.

[3] In a letter from Emmons to Marcou, dated Raleigh, N. C., December 29, 1860, he writes, "I made and published with my Report a modified map of the State, which showed the extent of the Taconic rocks in New York. The three thousand copies were stolen or destroyed by persons unknown, so that they were never issued with the proper volume. The rocks illustrating the Taconic system in the State Cabinet were all taken out, by order. . . . My existence as one of the State geologists was ignored at the last meeting of the American Association for the Advancement of Science in Albany [1851]. In fine, the persecution I suffered for opinion has rarely been equalled. . . . The editor of the *American Journal of Science* refused to publish my remarks upon Logan's report when he [Logan] announced his Huronian system, though their tenor was courteous in the extreme. I claimed that the Huronian was only the Taconic system." (Marcou on the Taconic System, 1885, Proc. Amer. Acad. Science, xii. 188.)

supposed to indicate the presence of magnesian silicates. Besides the three above named, there were, according to Emmons, two other divisions, the "Sparry limestone," by which he designated the Sparry Lime-rock of Eaton, and the "Taconic slate." This latter, which he declared to be quite distinct from the Magnesian slate, had, according to Emmons, been traced one hundred and fifty or two hundred miles, and included another band of roofing-slates. It is said to be more or less interstratified with limestones, and "often becomes a coarse graywacke." This Taconic slate, thus defined by Emmons in 1842 as the uppermost member of his "Taconic system," is, as will be seen, the First or Transition Graywacke series of Eaton.

Emmons, moreover, at this time calls attention to the fact that the Primitive Lime-rock, or Stockbridge limestone, "being often sparry, and of fine texture, is mistaken for the true Sparry limestone." He further remarks that as the succession of these disturbed strata is "unsettled, or at least not so clearly established as desirable," he follows their geographical order in describing them, but proceeds to tell us that the "Taconic slate" group lies between the so-called Hudson River or Loraine rocks on the west and the Sparry limestone on the east, and, moreover, that "it is undoubtedly overlapped by the former rocks, and passes beneath the latter with a dip of 30°–35°." The whole Taconic system was further described by him at this time as "the rocks lying between the upper members of the Champlain group and the Hoosic Mountains," and was, moreover, regarded "as inferior to the Potsdam sandstone, or as having been deposited at an earlier date than the lowest member of the New York Transition system."[1] The precise relations of this Transition system to the Silurian and Cambrian systems of the British geologists, and indeed the limits of these in England, were not at that date clearly understood; but Emmons, in 1842, supposed that the Taconic rocks in part might "be equivalent to the Lower Cambrian of Sedgwick," "*the upper portion being the lower part of the Silurian system*," to which the Middle and Upper Cambrian were then, on the authority of Murchison, very generally referred. That he accepted the extreme views of Barrande, and the pretensions of Murchison as to the downward extension of the limits of the Silurian, is shown by the language of Emmons, quoted farther on.

[1] Loc. cit., pp. 140, 144, 163.

§ 13. Meanwhile, Emmons continued his studies, and in 1844 published his monograph on the Taconic system, which was in 1846 republished in his "Agriculture of New York," where it forms Chapter V. (pp. 45–112). Therein, while giving a more detailed account of the Taconic system, he made one important and significant change. In 1842, while maintaining that the upper portion of this is "the lower part of the Silurian system," he had nevertheless supposed that the whole succession was deposited before the time of the lithologically dissimilar Champlain division, which, although the base of the New York system, was not by him regarded as the base of the Silurian. In this he was at variance with the teachings of Eaton, who already, as early as 1832, had declared the Transition or Sparry Lime-rock—which he placed at the summit of the Transition Graywacke or Taconic slate group—to be the stratigraphical equivalent of the Calciferous Sand-rock of the New York Transition system. Emmons had, previous to 1846, concluded that the formation of limestones of this sparry type "occurred at intervals during the whole period of the deposition of the Taconic slate," and, acquiescing in the judgment of Eaton, now declared that the upper portion of the Taconic system,—namely, the great belt of slates with limestones, sandstones, and conglomerates,—designated by him in 1842 as the Taconic slate, and including both the Transition Graywacke and the Sparry Lime-rock of Eaton, was the stratigraphical equivalent of the lower part of the Champlain division, and in fact a thickened and modified form of the Calciferous Sand-rock, which was now said to be, in its eastern extension, "protean" in its character, and to include a great variety of rocks.

§ 14. For the better identification of this Taconic slate group it is important to note that Emmons, who had already, in 1842, clearly defined its eastern and western limits in New York, and declared that it had been traced north and south a distance of one hundred and fifty or two hundred miles, repeats with detail, in 1844, the facts of its distribution. It is described as occupying geographically the interval between the overlying Loraine shales,—the upper part of the Champlain division,—on the west, and "the great mass of the Sparry limestone," which forms its eastern border, and itself lies at the western base of the Taconic Hills; which are made up of the three lower members of the Taconic system. He now adds that "the Taconic slate, with its subordinate beds, occupies almost the whole of Columbia, Rensselaer, and Washington Counties, and is of immense thickness." He describes it "from Lansingburgh to the Sparry limestone on the east" as having a breadth of at least twenty miles, and, while signalizing repetitions in the section, still supposes that its volume "exceeds that of all the members of the New York system put together," adding that, "without doubt, this immense rock admits of subdivision." He declares that in the breadth of fifteen or twenty miles across this belt "the observer will pass several times over the same beds, which are brought to the surface by successive uplifts."

The nature of the uplifts by which these subdivisions of the Taconic slate group are thus repeated is further shown by an ideal section, afterwards published in his "American Geology," ii. 48. The real order of succession, as then defined, was, at the base, greenish, chloritic-looking sandstones, followed, upwards, by a great variety of different colored slates, sandstones, and conglomerates, including, moreover, what is designated as sparry limestone, black shaly limestone, and, at the summit, fine black slates.

(To be continued.)

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 59.)

ARACACHA. *Aracacha esculenta* De C.

THIS South American plant is yet included among garden vegetables by Vilmorin. It was introduced to notice in Europe in 1829 and again in 1846, but trials in England, France, and Switzerland were unsuccessful[2] in obtaining eatable roots.[3] It was grown near New York in 1825,[4] and at Baltimore in 1828 or 1829,[5] but was found to be worthless. Lately introduced to India, it is now fairly established there, and Mr. Morris[6] considers it a most valuable plant-food, becoming more palatable and de-

[1] Director of the New York Agricultural Experiment Station, Geneva.

[2] Heuze, Les Pl. Alim., ii. 509.

[3] Decaisne & Naudin, Man., iv. 137.

[4] N. Eng. Farmer, July 22, 1825.

[5] Farmers' Library, 1847, 94.

[6] Gard. Chron., July 10, 1886, 50.

sirable the longer it is used. It is generally cultivated[1] in Venezuela, New Granada, and Ecuador, and in the temperate regions of these countries it is preferred to the potato. The first account which reached Europe concerning this plant was published in the "Annals of Botany," vol. i., about 1805. It was, however, mentioned in a few words by Alcedo in his "Diccionario Geographico de las Indias Occidentales ó America," 1789.[2]

The synonymy has been given as below:

Aracacha xanthoriza. Banc. Koen. Ann., i. 400.
Conium aracacha. Hook, Exot. Fl. Bot., 152.
Aracacha esculenta. De C., Prod., iv. 244.

ARTICHOKE. *Cynara scolymus* Lin.

The artichoke, *Cynara scolymus* L., is supposed by authors to have originated from the cardoon, *Cynara cardunculus* L., and the cardoon is indigenous at Madeira, the Canaries, Morocco, the Iberian Peninsula, the south of France, Italy, Greece, and the islands of the Mediterranean. It has become naturalized on a vast scale in Buenos Ayres and Chili.[3] It is now grown on a large scale in France and other portions of Europe for the flower-heads, the scales and buttons of which make a very palatable vegetable, and in America in private gardens.

The number of varieties of artichoke is extremely large, as through the cross-fertilization of the flowers the plants do not come true from seed, and hence desirable selections are propagated by dividing the stools, or from suckers. Vilmorin[4] describes thirteen varieties as sufficiently prominent for notice.

Whether the artichoke was cultivated by the ancients is in dispute among commentators, and Targioni-Tozzetti,[5] a most competent authority, says it was only known to the Romans in the shape of the cardoon, and that the first record of the artichoke cultivated for the sake of the receptacle of the flowers was at Naples in the beginning or the middle of the fifteenth century; it was thence carried to Florence in 1466, and at Vienna, Ermolao Barbaro, who died as late as 1493, only knew of a single plant grown as a novelty in a private garden, although it soon

[1] De Candolle, Orig. des Pl. Cult., 32. [2] Don, Gard. Dict., iii. 378.
[3] De Candolle, Orig. des Pl. Cult., 73.
[4] Vilmorin, Les Pl. Pot., 1883, 14; The Veg. Gard., 1885, 3.
[5] Targioni-Tozzetti, Hort. Trans., 1854, 143.

after became a staple article of food over a great part of the peninsula. It seems quite certain that no descriptions I can find in Dioscorides and Theophrastus among the Greeks, nor in Columella, Palladius, and Pliny among the Romans, but that can with better grace be referred to the cardoon than to the artichoke. To the writers of the sixteenth century the artichoke and its uses were well known. "Le Jardinier Solitaire," an anonymous work published in 1612, recommends three varieties for the garden.

The most prominent distinction between the plants, as grown in the garden, is the presence or absence of spines. Although J. Bauhin,[1] in 1651, says that seed from the same plant may produce both sorts, and I have verified the observation, yet I cannot but believe that this comes from the cross-fertilization between the kinds, and that this absence or presence of spines is a true distinction. Tragus describes both forms in 1552, as do the majority of succeeding writers.

The form of the heads form a second division, the conical-headed and the globe.

I. The *Conical-headed.* Of the varieties sufficiently described by Vilmorin, four belong to this class, and they are all spiny. This form seems to constitute the *French artichoke* of English writers. The following synonymy seems justifiable:

Scolymus. Trag., 1552, 866, *cum ic.*

Carduus, vulgo Carciofi. I. Matth., 1558, 322.

Carduus aculeatus. Cam. Epit., 1586, 438, *cum ic.;* Matth., ed. of 1598, 496, *cum ic.*

Thistle, or Prickly Artichoke. Lyte's Dod., 1586, 603.

Cinara sylvestris. Ger., 1597, 291, fig.

Carduus sive Scolymus sativus, spinosus. J. Bauhin, 1651, iii. 48, *cum ic.*

Artichokes, Violet. Quintyne, 1693, 187; 1704, 178.

Conical-headed Green French. Mawe, 1778.

French Artichoke. Mill. Dict., 1807; Am. Gard. Books, 1806, 1819, 1828, 1832, etc.

Vert de Provence. Vilm., 1883, 16.

De Roscoff. Vilm., l. c.

De Saint Laud oblong. Vilm., l. c.

Sucre de Genes. Vilm., l. c.

Etc.

[1] J. Bauhin, Hist., 1651, iii. 48.

II. The *Globular-headed.* To this form belong two of Vilmorin's varieties, and various other varieties as described by other parties. The synonymy which seems to apply is:

Scolymus. Fuch., 1542, 792, *cum ic.*

Cardui alterum genus. Tragus, 1552, 866.

Carduus, vulgo Cariciofi. II. Matth., 1558, 322.

Carduus non aculeatus. Cam. Epit., 1586, 437, *cum ic.;* Matth., 1598, 497, *cum ic.*

Right Artichoke. Lyte's Dod., 1586, 603.

Cinara maxima ex Anglia delata. Lob. ic., 1591, ii. 3.

Cinara maxima alba. Gerarde, 1597, 991, fig.

Cinarà maxima anglica. Gerarde, l. c.

Green or White. Quintyne, 1593, 187; 1704, 178.

Red. Quintyne, l. c.

Globular-headed Red Dutch. Mawe, 1778.

Globe Artichoke. Mill. Dict., 1807; Am. Gard. Books, 1806, 1819, 1828, etc.

Gros vert de Laon. Vilm. 1883.

Violet de Provence. Vilm., l. c.

Etc.

In growing five of Vilmorin's varieties from seed, variability was such that we had nearly as many varieties as plants, and among other sorts had one which in its head was precisely the *Cinara major Boloniensis* of the "Hortus Eystettensis,"[1] 1613; and another, which was the *Cinara seu Artischoche vulgatiss.* of the same.

The color of the heads also found mention in the early writers. In our first division, the French, the green is mentioned by Tragus in 1552, by Mawe in 1778, and by "Miller's Dictionary" in 1807; the purple by Quintyne in 1693. In the Globe class the white is named by Gerarde in 1597, and by Quintyne in 1693; and the Red by Gerarde in 1597, by Quintyne in 1693, and by Mawe in 1778; and Parkinson, in 1629, names the red and the white.

The so-called wild plants of the herbalists seem to offer like variations to those we have noted in the cultivated forms, but the difficulty of identification renders it inexpedient to state a fixed conclusion. The heads are certainly no larger now than they were two hundred and fifty years ago, for the "Hortus Eystetten-

[1] Hortus Eystet., 1713. Aut. ord., 4, fol. 5.

sis" figures one fifteen inches in diameter. The long period during which the larger part of the present varieties have been known seems to justify the belief that modern origination has not been frequent. "Le Jardinier Solitaire," 1612, describes early varieties,—le Blanc, le Rouge, and le Violet; Worlidge, in 1683, says there are several kinds, and he names the tender and the hardy sort. McMahan names the French and two varieties of the Globe in America in 1806; "L'Hort. Français," 1824, names the Blanc, Rouge, Violet, and the Gros vert de Laon; Petit, "Nouv. Dict. du Jard.," 1826, adds Sucre de Genes to the list; Noisette, in 1829, adds the Camus of Brittany.

The name given by Ruellius[1] to the artichoke in France, in 1536, is *articols*, from the Italian *articoclos*. He says it comes from *arcocum* of the Ligurians, *cocali* signifying the cone of the pine. The Romans call it *carchiophos*, and the plant and the name came to France from Italy. The names I have seen assigned are in alphabetical order: Arabs, *kharchiof*, *hirshuf*,[2] *raxos*, *harxos*;[3] Berber, *taga*;[4] Egypt, *charsjuf*;[2] Flanders, *artisjok*;[5] France, *carciophe*,[6] *artichaut*;[3] Germany, *strobildorn*,[7] *artischokè*;[5] Hindustanee, *kunjir*;[2] Holland, *artisjok*;[5] India, *kunjeer*, *ateechuk*;[8] Italy, *carciofo*, *articiocca*,[5] *archichiocco*;[6] Persia, *kunjir*;[2] Portugal, *alcachofra*;[5] Spain, *alcachofa*,[5] *cardo de conner*.[9]

Asparagus. *Asparagus officinalis* L.

The cultivated asparagus seems to have been unknown to the Greeks of the time of Theophrastus and Dioscorides, and the word *asparagos* seems to have been used for the wild plant of another species. The Romans of the time of Cato, about 200 B.C., knew it well, and Cato's[9] directions for culture would answer fairly well for the gardeners of to-day, except that he recommends starting with the seed of the wild plant, and this seems good evidence that the wild and the cultivated forms were then of the same type as they are to-day. Columella,[10] in the first century, recommends transplanting the young roots from a seed-bed, and devotes quite a space to their after-treatment, and he offers

[1] Ruellius, De Stirp., 1536, 644.
[2] Birdwood, Veg. Prod. of Bomb., 165.
[3] Dalechamp, Hist., 1587, ii. 1436.
[4] De Candolle, Orig. des Pl. Cult., 74.
[5] Vilmorin, Les Pl. Pot., 14.
[6] Cast. Durante, 1617, 91.
[7] Tragus, 1552, 866.
[8] Speede, Ind. Handb. of Gard., 164.
[9] Cato, c. 161, c. 6.
[10] Columella, lib. xi. c. 3.

choice of cultivated seed or that from the wild plant, without indicating preference. Pliny,[1] who wrote also in the first century of our era, says that asparagus, of all the plants of the garden, receives the most praiseworthy care, and also praises the good quality of the kind that grows wild in the island of Nesidis, near the coast of Campania. In his praise of gardens[2] he says, "Silvestres fecerat natura corrudas, ut quisque demeteret passim; ecce altiles spectantur asparagi; et Ravenna ternos libris rependit." (Nature has made the asparagus wild, so that any one may gather as found. Behold, the highly-manured asparagus may be seen at Ravenna weighing three pounds.) This evidences the likeness remarked between the wild and the cultivated form, and the recognition of the change produced by culture. Palladius,[3] an author of the third century, rather praises the sweetness of the wild form found growing among the rocks, and recommends the transplanting to such places otherwise worthless for agriculture, but he also gives full directions for garden culture with as much care as did Cato. Gesner[4] quotes Pomponius, who lived in the second century, as saying that there are two kinds, the garden and the wild asparagus, and the wild asparagus the more pleasant to eat.

The word Asparagus, as used by the Romans, meant the cultivated form, the word *Corruda* the wild plant. The original meaning seems to have been a succulent shoot, for in this sense it was frequently used by the Greek writers. In the European languages we have the continuance of the word under various forms, as *Sperage* by Turner, 1538; *Asparagus* by Gerarde, 1597 and to date, as also *Sparrowgrass*. In Denmark, *Asparges;* in France, *Asperge* or *Esparge* in 1586; in Germany, *Epargen* in 1586, *Epargel* in 1807, and *Spargel* at the present time; in Greece, *Asparaggia;* in Holland, *Aspergie* in 1807, *Aspersie* now; in Italy, *Asparagus* in 1586, and *Sparagio* at present; in Portugal, *Espargo;* in Russia, *Sparsa* or *Sparsch;* in Spain, *Asparrago* and *Esparrago;* and in Sweden, *Sparis* or *Spargel.*[5]

In extra-European languages the following names appear: By the Moors, *halion* or *helium*, Cam. Epit., 1586; in Arabic, *yer-*

[1] Pliny, lib. xix. c. 42. [2] Ib., c. 19.

[3] Palladius, lib. iii. c. 24; lib. iv. c. 9.

[4] Scriptores Rei Rust., 1788, Lexicon, art. Asparagus.

[5] See Miller's Dict., 1807; Camerarius, Epit., 1586; Vilmorin, Les Pl. Pot., 1883.

amya, marchoobeh;[1] in India, *marchooba, nagdoon*, or *asfuraj;*[2] Hindustanee, *hilyoon, nagdoun;*[1] in Persian, *margeesh;*[1] in Japan, *kikak kosi;*[3] in the Mauritius, *asperge.*[4]

The expression of Parkinson, 1629, "a delectable sallet-herbe," implies the consideration in which for many centuries it has been held. Its culture in Italy was, as we have seen, quite general in ancient times. We have no records of its first appearance in the various countries of Europe, but it is mentioned in England by Turner in 1538, and as under cultivation by Gerarde in 1597. In France[5] it was well known in 1529. In America "*Sparagus*" is mentioned in Virginia in 1648,[6] and in Alabama in 1775,[7] and in 1785 Cutter mentions asparagus as if it was then a well-known vegetable in Massachusetts.

The wild plant is indigenous to Europe; as an escape from gardens it is often noted in America, not only in waste places on the coast, as Gray states, but also inland. There are no essential points of difference between the wild and cultivated forms; such as are noted between the escapes and the garden plants are only such as come from protected culture and rich soil; the figures in the ancient botanies do not indicate other variation than this, and the few varieties, so called, of our gardens have no especial importance, the differences being but in minor points, and but indicative of a careful selection and high culture, the ordinary variability of a variety furnishing plants which are propagated by division.

The point I wish to make regarding this vegetable is this, that although under high cultivation now for over two thousand years, under diverse climates and treatment, yet it has remained constant to type. The directions given by the Roman writers to plant the seed of the wild plant might be followed to-day with our escapes without detriment. It has given no variety types that have been recorded from the time of Cato up to this present year of grace. Where, then, is this boasted power of man by which he is supposed to modify our wild plants into improved types? It probably does not exist. The types of our cultivated plants have been apparently taken from nature, as produced by

[1] Birdwood, Veg. Prod. of Bomb., 187.
[2] Speede, Ind. Handb. of Gard., 1542, 160.
[3] Thunberg, Japan, 139.
[4] Bojer, Hort. Maur., 1837, 350.
[5] Ruellius, Dioscorides, 1529, 124.
[6] A Perfect Desc. of Va., 1649, 4.
[7] Roman's Nat. Hist. of Fla., i. 115.

the slow process of natural selection, and the influence of selection and diverse cultivations has been but to secure variation within the type limits, and such variations are usually of the character which may be described as expansion under culture, or its opposite; as smoothness and regularity of form; as enhanced quality.

ASPARAGUS BEAN. *Dolichos sesquipedalis* L.

This bean was described by Linnæus[1] in 1763, and I find no record of an earlier notice. It reached England in 1781.[2] Linnæus gives its habitat as America, and Jacquin received it from the West Indies. Martens[3] considers it as a synonyme of *Dolichos sinensis* L. Loureiro's description of *D. sinensis* certainly applies well to the asparagus bean, and Loureiro[4] observes that he thinks the *D. sesquipedalis* of Linnæus the same. He refers to Rumphius's "Amboina," l. 9, c. 22, tab. 134, as representing his plant, and this work, published in 1750, antedates the description of Linnæus. I think this is probably an East Indian plant, introduced to the West Indies, but I am unable from my notes to present the varieties and the forms which have been included under *D. chinensis.*

The name of Asparagus bean comes from the use of the green pods as a vegetable, served as a string-bean, and a tender asparagus-like dish it is. The name at Naples of *Fagiolo e maccarone* conveys the same idea. The pods grow very long, oftentimes are two feet in length, and hence the name of *Yard-long* often used.

The *Asparagus* or *Yard-long bean* is mentioned for American gardens in 1828,[5] and probably was introduced earlier. It is mentioned for French gardens under the name of *Haricot asperge* in 1829.[6] There are no varieties known to our seedsmen, but Vilmorin offers one, the *Dolique de Cuba.*[7]

The names under which it is known are: in France, *dolique asperge, haricot asperge;* in Germany, *Americanische riesen-spargel Bohne;* in Holland, *Indianische boon;* in Italy, *fagiuolo spara-*

[1] Linnæus, Sp. 1763, 1019.
[2] Miller's Dict., 1807.
[3] Martens, Die Gartenbohnen, 100.
[4] Loureiro, Fl. Cochinch., 1790, 436.
[5] Fessenden, New Am. Gard., 1828.
[6] Noisette, Man. du Jard., 1829.
[7] Thorburn's Seed Cat., 1828.

gio,[1] *fasoi longhi, fagiolo e maccarone;*[2] at Cayenne, *pois rubran;*[1] at Barbadoes, *Halifax pea;*[3] at Jamaica, *asparagus bean;*[4] in Cochin China, *dau dau* and *tau co.*[5]

(To be continued.)

THE EAST GREENLANDERS.

BY JOHN MURDOCH.

THE veteran authority on the Eskimos, Dr. Rink, has recently published an able and interesting paper on this easternmost outpost of the great Eskimo race,[6] in which he reviews the ethnological results of the late successful Danish expedition to East Greenland under Captain Holm, and draws important conclusions as to the original home of the Eskimos, and the probable course of the wanderings by which they have reached their present habitations.

In his opinion, the metropolis of the Eskimos is probably to be found in Alaska, and he finds a confirmation of this view in the fact that here the Eskimos are not confined to the coast, but spread inland along the rivers.

It is a fact, however, that the proportion of the Eskimos of Alaska who really dwell in the interior is very small indeed, being confined to the valleys of the Kuskokwim and the adjoining less important rivers, and to the three rivers emptying into Kotzebue Sound, while along the rest of the coast from Kadiak to Point Barrow they are as purely littoral—or "Orarian," to adapt Mr. Dall's term—as in Greenland or Labrador. Nevertheless, this scanty remnant may represent the original condition of the race.

He believes that the migrations of the race can be traced by the development of certain inventions as we pass along the shores of the continent from Alaska to Greenland. For instance, the kayak, which is probably, as he believes, derived from the open

[1] Vilmorin, Les Pl. Pot., 280. [2] Martens, l. c. [3] Schomburgkh, Hist. of Barb.
[4] Macfadyen, Jam., i. 288. [5] Loureiro, l. c.
[6] Die Ostgrönländer in ihrem Verhältnisse zu den übrigen Eskimostämmen. Von H. Rink. Deutsche geographische Blätter, vol. ix. No. 3, 1886, pp. 228–239.

birch canoe, still used by the Eskimos of the Upper Kuskokwim, is far heavier and more clumsy in the west than in the intermediate regions, and reaches its highest development in Greenland.

It is, however, to be noted that the kayaks in use along the shores of the Arctic Ocean from Bering Strait to Point Barrow are far superior to those used by the nearest Eskimos to the eastward of that point, and approach closely in lightness and elegance to those of the Greenlanders, though essentially different in model.

According to our author, the use of the double-bladed paddle among the true Eskimos (excluding the Aleuts) does not begin till we reach the mouth of the Yukon, and is only used when speed is specially desired, even as far as Point Barrow, while a single-bladed paddle is sometimes used in the kayak as far as the Mackenzie. Moreover, the art of turning completely over in the kayak and righting oneself by means of the paddle is very unusual on the Alaskan coast, and completely developed only in Greenland.

A similar course of development, Dr. Rink believes, may be traced in the set of weapons with which the kayak is fitted out. He considers the "bird-dart" and "bladder-dart" (the former a javelin with a cluster of prongs at the middle of the shaft for taking fowls in the water, and the latter designed for catching seals, and therefore provided with an inflated bladder to impede the motions of the wounded animal) to be developments of the arrow, and the large harpoon, with a bladder attached by a line, to be a development of the latter, and finds the more primitive forms of these weapons more generally used in the south and west, while the more highly-developed forms gradually appear as we approach Greenland.

Our extensive collections at the National Museum tend to confirm these conclusions. The larger part of the harpoons from the region south of Bering Strait, even those of large size for capturing the beluga, are of the type of the "bladder-dart," or of the still more simple type without a bladder, in which the shaft itself is made to act as a drag by attaching the line to it in a martingale, and these, especially to the southward, are often feathered like arrows. Even as far as Point Barrow the only projectile weapons used in the kayak are the bird-dart and a small "martingale-dart."

The custom of wearing the labrets, or peculiar lip-studs of the western coast, which extends as far as the Mackenzie region, is believed by Dr. Rink to be a custom which the wandering Eskimos brought with them from their original homes, when they were in contact with the labret-wearing Tlinkets.

On this supposition, however, it is difficult to account for the abrupt way in which a custom universal up to Cape Bathurst ceases at that point, without a vestige of it traceable anywhere to the eastward. When we consider that there is now a long stretch of uninhabited country between the natives of Cape Bathurst and their neighbors in the east, with whom they have no communication, is it not more probable that the labret-wearing habit is one of comparatively recent date, which, spreading from the south and west, only reached the Mackenzie region after communication with the east was severed?

Dr. Rink derives a similar argument from the dwellings of the Eskimos, which in Southern Alaska resemble those of the Indians, having a fireplace in the middle of the floor.

As we go north and east the fireplace is replaced by the oil-lamp, and snow-huts gradually take the place of houses, till in Greenland we find edifices of earth or turf and stones and drift-wood. The form of the house also changes from square or round to an oblong shape in Greenland, capable of being added to at the ends in proportion to the number of the household. This extension reaches its greatest development in East Greenland, where the whole village occupies a single house.

These large dwelling-houses also furnish a substitute for the large public club-houses, for working, and social and religious assemblies, so common among the Eskimos and also usual among the Indians. Such houses as these are no longer found in Greenland, if they ever existed there, and are but partially represented among the eastern Eskimos by a sort of large snow-houses. The periodical festivals and masked dances, so frequent in the west, are less frequently practised as we approach Greenland, apparently in proportion as the influence of the *angokoks*, or wizards, increases.

The greatest similarity between the branches of the race is to be seen in the language. According to Dr. Rink, the number of "radical words," or those which form the basis of the intricate compounds used in the language, which differ from the Greenlandic or are doubtful in the other dialects, may be roughly stated in percentages, from the material at his command, as follows: in the Labrador dialect, fifteen per cent.; in the middle regions, twenty per cent.; in the Mackenzie region, thirty-one per cent.; and in Alaska, fifty-three per cent. A careful study of the vocabulary collected by our expedition (U. S. International Polar Expedition to Point Barrow, Alaska), containing over one thousand words, in which about five hundred and fifty radicals may be distinguished, has convinced me that only fifteen per cent. of these are different from the Greenlandic radicals.

There is no doubt, as our author believes, that the inhabitants of East Greeland and Alaska, brought together and allowed sufficient time, could easily learn to understand each other. In fact, the interpreters from Labrador who accompanied the English explorers had no difficulty in conversing with the western nations, and I have seen American whalemen, who had made themselves familiar with the Eskimo jargon in use at Hudson's Bay, converse fluently with the natives of Point Barrow.

Dr. Rink believes that the dialectic differences indicate that the Aleuts were first separated from the parent stock, then, and much later, the Southern and Northern Alaskan Eskimos, those of the Mackenzie, and finally those of the middle region, and that Labrador and Greenland were peopled by branches from the last.

Coming, now, to the consideration of the peculiarities of the newly-discovered East Greenlanders, he considers them in much the same condition as their western neighbors when described by Egede. One noticeable peculiarity about their harpoon is mentioned,—namely, that the head is fastened to the shaft by a pivot, as in the "toggle-iron" used by civilized whalemen, whereas among all other Eskimos the head slips off the shaft and "toggles" at right angles to the line. The harpoon-float is made of two bladders instead of one, and the old implements for taking seals on the ice, abandoned on the west coast since the introduction of firearms, are still in general use.

The bow is no longer used, owing to the disappearance of the reindeer, but cross-bows are used as toys by the children, or for shooting birds. The knowledge of this weapon, the writer believes, is due to foreign influence. They have no fish-hooks, but take fish with the net or a three-pronged spear like those used by the Eskimos in many other regions.

Their artistic taste and skill is very great, and equals, or even excels, that of the long-famous Alaskan Eskimos. Their carvings often consist of little figures carved from bone or ivory, fastened with pegs to wooden surfaces. All sorts of implements are ornamented with such carvings, representing natural and imaginary objects or conventionalized ornaments. The most extraordinary of their objects of art are the relief maps carved in wood, in which the islands are represented by separate pieces, attached to the mainland by thongs.

Much taste is also exhibited by the women in ornamenting and embroidering their clothing (in which, again, they resemble the Alaskan Eskimos), though their needles are all home-made, hammered and ground out of old iron obtained from wrecks.

The inhabitants of each winter village appear to form one large household, more or less under the control of a single head, chosen apparently by tacit consent, and whose commands often do not need to be expressed. The head of the household was observed to give definite commands as to the order in which the eight families of his household should take their places on the sleeping platform, how the lamps should be lighted and the windows closed. During the winter one young man was expelled from the house by way of punishment, and compelled to seek shelter elsewhere. Hospitality is universal, as with the Eskimos everywhere.

The largest of the several "village-houses" on the Argmagsalik fjord, where Captain Holm wintered, contained fifty-eight people. The house nearest Captain Holm's winter-quarters had eight families, thirty-eight souls living and performing all their work, sleeping, cooking, eating, singing, and dancing in a space twenty-seven feet long, fourteen and a half feet wide, and at the utmost six and a half feet high!

Much valuable linguistic material was collected, thanks to their excellent interpreters, Christian West Greenlanders, and fifty-one interesting traditions, of which thirteen are plainly identical with those of other Eskimos, while in thirteen others are recognizable well-known traditional elements. From a preliminary examination of the linguistic material, it appears that there is more difference between the dialects of East and West Greenland than between the well-known North and South Greenland dialects.

Captain Holm is of the opinion that the East Greenlanders travelled round Greenland from the north, while the West Greenlanders came down southward along the shores of Baffin's Bay, meeting the others at the southern point of Greenland, and there forming a mixed race. The author considers that the differences described favor this hypothesis, but thinks it too early to draw a general conclusion from the facts at hand. He adds that the mixed race in all probability also contains Scandinavian elements, though not the slightest trace of Scandinavian culture is to be discovered.

In a foot-note at the beginning of the article Dr. Rink states that the direct inspiration of the paper was the fact that he had the opportunity of studying the rich ethnological collection from East Greenland in company with Captain Holm, and also personally received information about the western Eskimos from the brothers Krause and A. Jakobson, and about those of the middle region from Dr. F. Boas. He also courteously acknowledges the information received from other sources, especially from those in America who are engaged in studying similar subjects.

U. S. NATIONAL MUSEUM.

THE SIGNIFICANCE OF SEX.

BY JULIUS NELSON.

(Continued from page 42.)

EXPLANATION OF PLATES VI.—VIII.

Figs. 94 to 124, *h*, illustrate cell-division (94–104 are Protozoan), and Figs. 124, *j*,–133 illustrate fertilization (*i.e.*, the union of male and female pronuclei).

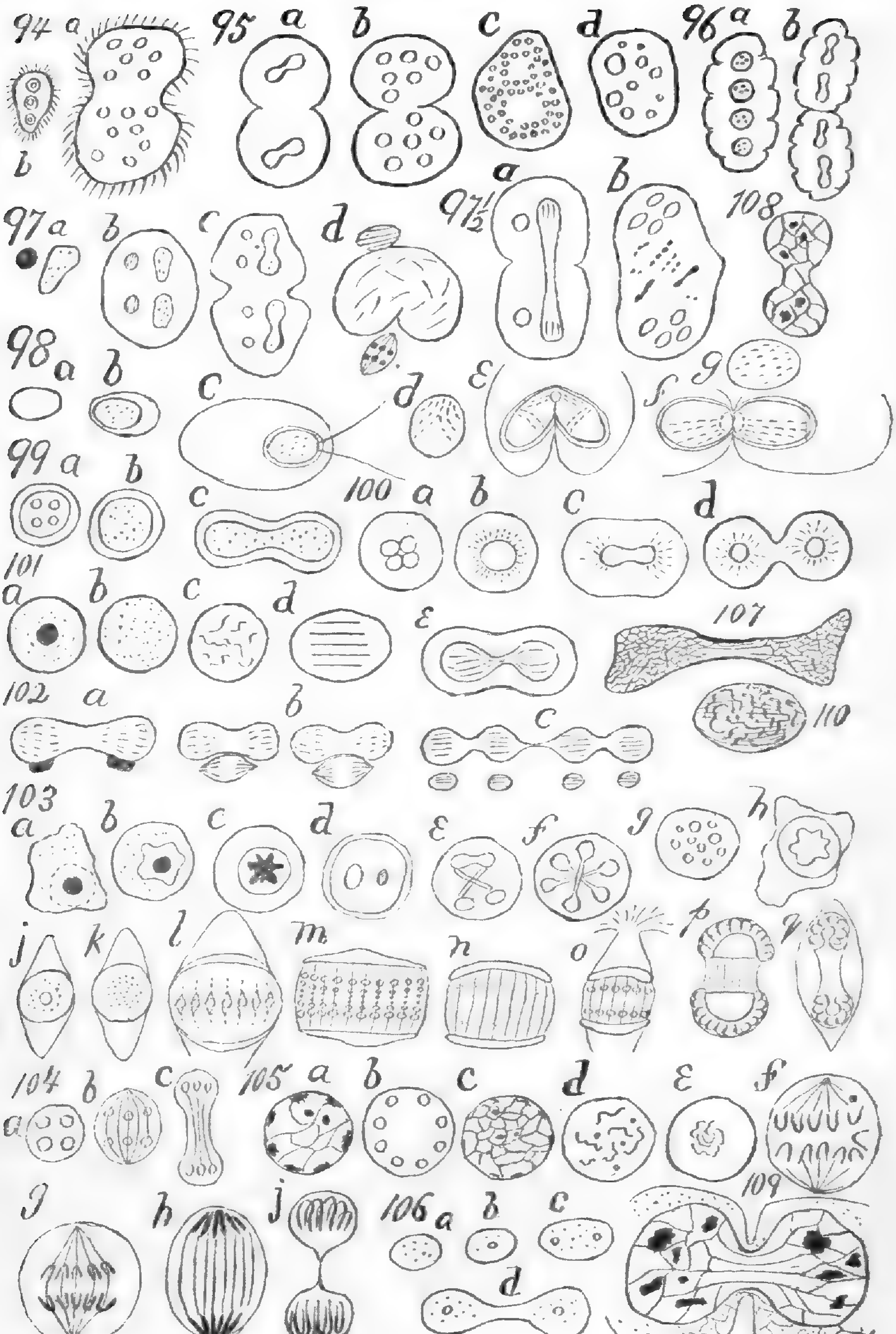
PLATE VI.

FIG. 94, *a–b*. *Opalina ranarum*—Kent, Plate 26. See also Nussbaum, A. m. A., xxvi., and Zeller, Z. w. Z., xxix.—This "unicellular" animal is multinucleate, and the nuclei multiply by karyokinesis (see Figs. 104, 105) independently of cell-division. The latter takes place successively as in *a*, until small cells like *b* result, containing few nuclei. These become encysted and the nuclei fuse to become one. Then the mononucleate animal escapes and increases in size, while the nuclei become more numerous again. Their number may rise to hundreds.

FIG. 95, *a–d*. *Oxytricha scutellum*—Gruber, Z. w. Z., xl.—As this infusorian grows the number of nuclei increases by direct division until we have a form like *c*, then the nuclei fuse (*d*) to become one, and then once more divide. As this proceeds the cell-body is constricted between the groups of nuclei as shown in *a* and *b*.

FIG. 96, *a–b*. *Polycricus schwartzii*—Bütschli, A. m. A., ix.—This infusorian

PLATE VI.



usually has a row of four nuclei as in *a*, but when division takes place the nuclei divide so as to furnish the daughters with the normal number (*b*).

FIG. 97, *a–d*. *Stylonychia histrio*—Nussbaum, A. m. A., xxvi.—Here we have two sorts of nuclei, a small spindle-shaped "paranucleus," which in division presents the spindle-fibres and microsomata of karyokinesis, and a large nucleus whose "nuclein" substance is more irregularly distributed. In a resting state (*a*) the paranucleus is homogeneous and nearly spherical, the nucleus has small bodies in it that resemble the paranucleus. When cell-division takes place (*b, c*) both sorts of nuclei divide so that the daughter-cells are multinucleate, but when these return to the "resting" condition the nuclei fuse once more, as seen in *d*. Here the nuclein bodies of the nucleus are drawn out into filaments.

FIG. 97½, *a–b*. Represent[illegible] vision of *Paramœcium*,—from article "Protozoa" in Encyclopæd. Brit., by Lankester. Here the paranucleus divides into two groups of four each, but the nucleus divides up much finer and strongly suggests beaded filaments. Bütschli in A. m. A., ix., figures the nucleus as broken up more irregularly.

FIG. 98, *a–g*. *Polytoma uvella* (*a–c, f–g*) and *Dallingeria drysdali* (*d* and *e*) —Dallinger, Jour. R. Micr. Soc., April, 1886.—After conjugation (see Fig. 131) the fertilized nucleus of the monad is dissolved throughout the protoplasm in ultra microscopic particles (gemmules), and when the cyst bursts these are projected out, and soon grow so as to be visible to a power of fifteen thousand diameters, until finally they attain the size and shape seen in *a*, then granules appear in their substance, and at the same time a clear zone of protoplasm (*b*) is secreted about this body, which henceforth is the nucleus (*c*). When division is to take place the granules arrange themselves in regular lines as in *d*, and a peculiar and simple karyokinesis follows (*c–f*), with return of granules to normal distribution in *g*, a daughter-nucleus.

FIG. 99, *a–c*. Nucleus of *Chromulina woroniana*—Fisch, Z. w. Z., xlii.—The wall of the nucleus is thick and contains nuclein, but there is also a nucleolus which segments up into fine granules, while simple constriction of the nucleus ensues (*a–c*), and when the daughter-nuclei are established, these granules fuse and return by inverse kinesis to the normal state.

FIG. 100, *a–d*. Nucleus of *Cyathomonas truncata*—Fisch, l. c.—This is thin-walled, and most all the chromatin is in the nucleoli. In *a* four of these bodies are seen. In *b* we see rows of granules raying out from the nucleolus, and the nucleus and nucleolus behave in division much as if the former were a cell and the latter its nucleus; finally, after division (*c–d*), the rays disappear, and we get a simple nucleus with a nucleolus.

FIG. 101, *a–e*. Nucleus of *Cordosiga botrytis*—Fisch, l. c.—We have first a clear vesicle containing a nucleolus, the latter gradually dissolves into granules (*a, b*), and the granules fuse to filaments (*d*), which arrange themselves parallel to one another like a spindle, and then the fibre-bundle constricts, followed by the nucleus (*e*). The original state is assumed by the daughter-nuclei passing through an inverse series of changes: thus from *e* we get successively *d, c, b, a*, etc.

FIG. 102, *a–b*. *Onychodactylus acrobates*—Entz, Mitt. Neap., v.; *c*, *Stylonychia mytilus*—Bütschli (from Kent, Plate l.).—Division of nucleus and paranucleus during cell-multiplication. The nucleus and paranucleus remain closely applied to each other; the latter *leads* in division. The segments of the former remain united by a bridge (*c*), the centre one only being severed by cell-division as in *b*.

FIG. 103, *a–q*:—*a–c*. Nucleus of *Spirochona gemmipara*—Hertwig, Jenaische Zeitschrift, xi. *d–q* is a nucleus of *Actinosphærium eichornii*—Hertwig, Z. z., xviii.; see Gruber, Z. w. Z., xxxviii.—*a–c* show the amœboid powers of nuclear substance;

in *a* the phenomena are restricted to the nucleus; in *b* to the hyaline body which holds the nucleolus, and at last, in *c*, the nucleolus is sending out ray-like pseudopodia, which become the chromatin fibrils. A spindle is finally formed with a hyaline end-plate at each end. *d–h* show different states of a nucleus in the "resting" condition. In *d* we have a nucleolus and paranucleolus; these segment and become related, as in *e* and *f*. In *g* the nucleolus is much segmented. *h* shows us the nucleus preparing for division; the special protoplasm sheet lining the nucleus is amœboid, as is also the nucleolus. The former, at last, gathers as two polar caps (*j*), while the latter dissolves to granules (*k*); at first the granules are in the centre of the nucleus, then they pervade its whole substance, and finally a peripheral clear zone is established (*k*). The substance of this zone then moves to the poles, forming a "polar plate," while the granules aggregate in vertical lines, and fuse more and more towards the equator to form an equatorial plate of microsomata (*l*). Then segmentation begins again, and the daughter-microsomata move apart towards the poles (*m*). On their way they form a continuous plate or zone of very minute granules (*n*), but sometimes the groups may be shown to be still distinct, as at *o*, which also shows the polar *stars* ("asters") raying out from the protoplasmic cap. The microsomata are received and absorbed by the polar plate in a rosette-like figure (*p*). The polar plate invaginates like a gastrula, while the spindle constricts; the polar masses of protoplasm flow down on the sides (*q*), and are at last themselves constricted to serve as an envelope for the daughter-nuclei; the spindle-fibres are absorbed into the cavity of the gastrula-like "calotte," and a stage-like *h* results. The substance of these fibrils is probably that which is separated from the nucleolus to form the paranucleolus.

FIG. 104, *a–c*. A nucleus of *Opalina ranarum*—Nussbaum, A. m. A., xxvi.—The nucleus divides by first forming four "microsomata nucleoli," seen in polar view in *a*. These microsomata divide and move along fibres to the poles, as in *b*, and simple constriction, as in *c*, and reversion to uninuclear condition follows.

105, *a–j*. A nucleus of *Opalina ranarum*. According to Pfitzner (M. J., xi.), *a* shows an irregular reticulum or "knäuel" with a couple of nucleoli and irregular masses of chromatin at the surface. In *b* the chromatin has become aggregated in superficial microsomata. These are forms of resting nuclei. The initial condition from which division proceeds is seen in *c*. We have an abundant knäuel and a few nucleoli; then in *d* the knäuel (skein) filament segments; next, in *e*, the segments are concentrated to the centre. The nucleoli may or may not be absorbed. Now there ray out fibres from an "amphiaster" towards the centre from two opposite points, and the segments of nuclein arrange themselves into an equatorial plate (*f*), and, splitting each into two, send the regular number of V-shaped loops along the fibres of the spindle to the poles (*g*, *h*). Constriction follows (*j*), and the segments once more fuse into a "skein-filament" or a "reticulum." This gives us as complicated a form of karyokinesis as we find in the cells of metazoa.

FIG. 106, *a–d*. Nucleus of embryonic cells of *Scorpion*—Blochmann, M. J., x.—To show "direct" division A nucleolus is built up from *a* to *b*; the nucleolus then divides, next the nucleus does so, and at last the cell constricts according to the Remakian scheme.

FIG. 107. Nucleus of *Vorticella* in division—Carnoy, p. 217.—Shows a simple constriction without modification of the net-work.

FIG. 108. Epithelium nucleus from gut of *Astacus*—Frenzel, Mitt. Neap., v.—No karyokinesis during division, though we have a reticulum and nucleoli.

FIG. 109. Male ovum of *Pelobates fuscus*—Carnoy, p. 40.—Cell and nucleus suffer

PLATE VII.

111 a b c d ε f g
h j k ε f g
112 a b c d
114 b a
113 a b c d ε
f g
115 a b c d ε
116 b a c d
117
118 a b c ε
x w' x² w
d
dy
dz
119 a b c d ε f
g h j k l
fw fx fy fz
120
121

simple constriction; the segments of the nucleolus are thus separated without a spindle,—a mode of division known as "stenosis."

FIG. 110. Nucleus of muscle-fibre of larva of *Hydrophilus* (Carnoy, p. 240) entering into division. The segments of the nuclein filament are seen lying among the fibres of the spindle, which latter have been transformed from the karyoplasmic network.

PLATE VII.

FIG. 111, *a–k*. Nucleus from cells of endoderm of Cœlenterates except (*k*) which is ectodermal—Pfitzner, A. m. A., xxii.—*a* gives the "skein" reticulum; *b* shows the skein-filament segmented, while the nucleolus has divided. In *c* we get the segments in centre; in *d* the nucleoli have dissolved; in *e* the polar asters have formed a spindle, and the segments have formed a "rosette" in its equator; *f* shows the "rosette" broken up into loops by segmentation of outer limbs of the rosette. This is the "monaster" stage, and when the loops have split and duplicated themselves we get in *g* the "dyaster." *h* shows the spindle with the loops near the poles and with astral rays streaming out into the cytoplasm; *j* shows the constriction of spindle and of cell; in *k* we have a true skein-filament that does not form a reticulum.

The formation of the cell "plate," where (as in plants) there is no cell constriction, may be seen in Figs. 124, *h* and *s*, and modern text-books on botany.

FIG. 112, *a–g*. Karyokinesis from epithelium of *Salamander*—Flemming, A. m. A., xviii.—*c*, *d* are from testes as seen in living state. Here we see bodies at the poles nearly corresponding in number to the segments of the filament. When the dyaster is formed they are about twice as numerous, and strongly suggest that they are a species of paranucleolus. *cf.* 97½, 103, etc. In the daughter-nuclei the series *a*, *b*, is inversely followed, as in *e*, *f*, *g*. In *g* the filament is cut across by the knife in many of its windings, thus giving us pseudo-nucleoli.

FIG. 113, *a–g*. Epithelium of *Salamander* according to Rabl, M. J., x.—*a* is a schematic side view, and *b* a polar view of a resting nucleus. According to Rabl the segments of the filament do not fuse or in any way anastomose in the resting nucleus, but simply branch out finer and finer. Then in kinesis the branches are withdrawn, and short thickish loops are formed. The spindle is first seen in its entirety at one pole, which, as seen in *a* and *b*, is different from the other pole, and then the spindle turns at an angle of 90° and forms the usual amphiaster (*c*, *d*). When the loops split, the halves are carried apart at their *bend* first, and the shorter arms of the U are first separated as seen in *e*. Arriving at the poles the loops branch out once more, as in *f*, to form the figure *a*. In *g* we see a daughter-nucleus from testicular epithelium of Proteus, where the branching does not take place, but the loops are formed of a row of microsomata (beaded filament).

FIG. 114, *a–b*, shows how such a beaded filament splits by each microsoma dividing in the general plane of the loop. Pfitzner, M. J., vii.

FIG. 115, *a–e*. Nucleus from growing point of *Tradescantia virginica*—Strasburger, "Zellbildung u. Zelltheilung," Jena, 1880.—The nearly homogeneous protoplasm of the nucleus (*a*) becomes granular; the granules fuse and arrange themselves in rows of microsomata (*b*), and these rows are cut across (*c*) in the equator and pushed towards the poles while undergoing various changes of segmentation back to granules again, but a central nucleolus remains undissolved, or rather is built up during the process of reconstruction of the daughter-nucleus (*d*, *e*).

FIG. 116, *a–e*. Nucleus of *Spirogyra majuscula*—Strasburger, l. c.—In *a* we see the lenticular nucleus with its nucleolus; *b* is a face view showing it becoming granular. In *c* the nuclein has segmented (or aggregated?) into more and more numerous masses or microsomata which soon reach the granular state again (*c*, *d*, *e*). Meanwhile the nucleus flattens more and becomes biconcave; the granular protoplasm gathers in the concavities and sends across and through the nucleus the spindle-fibres (*e*); the marked boundary of the nucleus is dissolved, and the equatorial plate of granules splits and moves towards and into the polar masses, while the intervening portions of the spindle-fibres ("connecting fibrils") spread out and help build the cell-plate.

FIG. 117 is from *Spirogyra nitida*, where the nucleus is more spherical and the spindle-fibres are at first aggregated towards the centre in union with the central granular mass of chromatin, and they become more spread out as the nucleus loses in outline and the chromatin is divided into its daughter portions. We see also that the latter is confined to the central fibres of the spindle.

FIG. 118, *a–dz*. Nuclei from protoplasmic layer next wall of embryo-sac of *Galanthus nivalis*—Strasburger, A. m. A., xxiii.—*a*, first step towards karyokinesis; the microsomata form a continuous beaded filament, produced by the shortening of a finely-wound "skein" or "tangle," the meshes of whose reticulum give a finely granular appearance to the protoplasm. A large nucleolus exists besides. This is dissolving and adding itself to the filament in *b*, where the boundaries between the microsomata are not indicated in the diagram. *c* is the "segmented stage," in which we have on both sides of the equator segments whose equatorial ends are bending around like hooks (only a few segments are shown). Next, the hooks split longitudinally, and the halves of each hook seek opposite poles; to do this there must be a stage where one-half of the loops of the southern hemisphere cross the equator and meet corresponding hooks from the northern on their way to the southern hemisphere. (See *d*, where *w* and *w′* are the corresponding halves of the southern hooks, and *x* and *x′* of the northern hooks. *w′* and *x′* are represented as having just crossed.) While this "metakinesis" is progressing the hooks become more U-shaped, and taking the northern daughter-nucleus, as in *dy*, we can see how its skein-filament is reconstituted in *dz*, by union of neighboring limbs of the sets of loops. (Metakinesis refers to the changes that take place after the splitting of the loops or microsomata to form the chromatin figures which are to occupy the daughter-nuclei. The preceding changes constitute the "prophase," the succeeding, the "anaphase.")

FIG. 119, *a–l*. From wall of embryo-sac of *Fritillaria imperialis*—Strasburger, A. m. A., xxiii.—*a–d* represent the prophase, *e–f*, the metaphase, *g–l*, the anaphase. Here the first step of the metaphase is, as in the last case, one of mutual transfer between the opposite sides of the equator. (See *f*.) Following any one loop in the northern hemisphere, splitting into two halves (1, 2, Fig. *fw*), the part 2 is destined for the northern daughter-nucleus, and 1 for the southern. Separation between the two halves proceeds from one end to the other, so that the part 1 becomes pulled out straight, one limb of the part 2 is held back, while the other is dragged towards its own pole (*fx*), both halves are therefore acted on so as to be pulled into line parallel with a meridian, but the end, as it approaches the pole, bends around hook-shaped to form a new loop, hence the part 2 passes through an "S" stage (*fy*), and the part 1 a hook stage, and they finally reach the U stage in *fz*, when the stages *dy* and *dz* ensue, as in the preceding figure. On comparing Figs. *f–l*, it will be seen that practically this mathematical regularity is never attained, but only distantly approximated. The number of loops in Strasburger's figures is far greater than in the diagram, but they may be deciphered and understood by means of the diagrams (Fig. *f–fz*). The main source of departure is found in the fact that most of the loops are not perfect U's in the anaphase, but are oftener hooks or even straight filaments lying in the meridians. In the last case *fw* and *fx* would be omitted.

PLATE VIII.

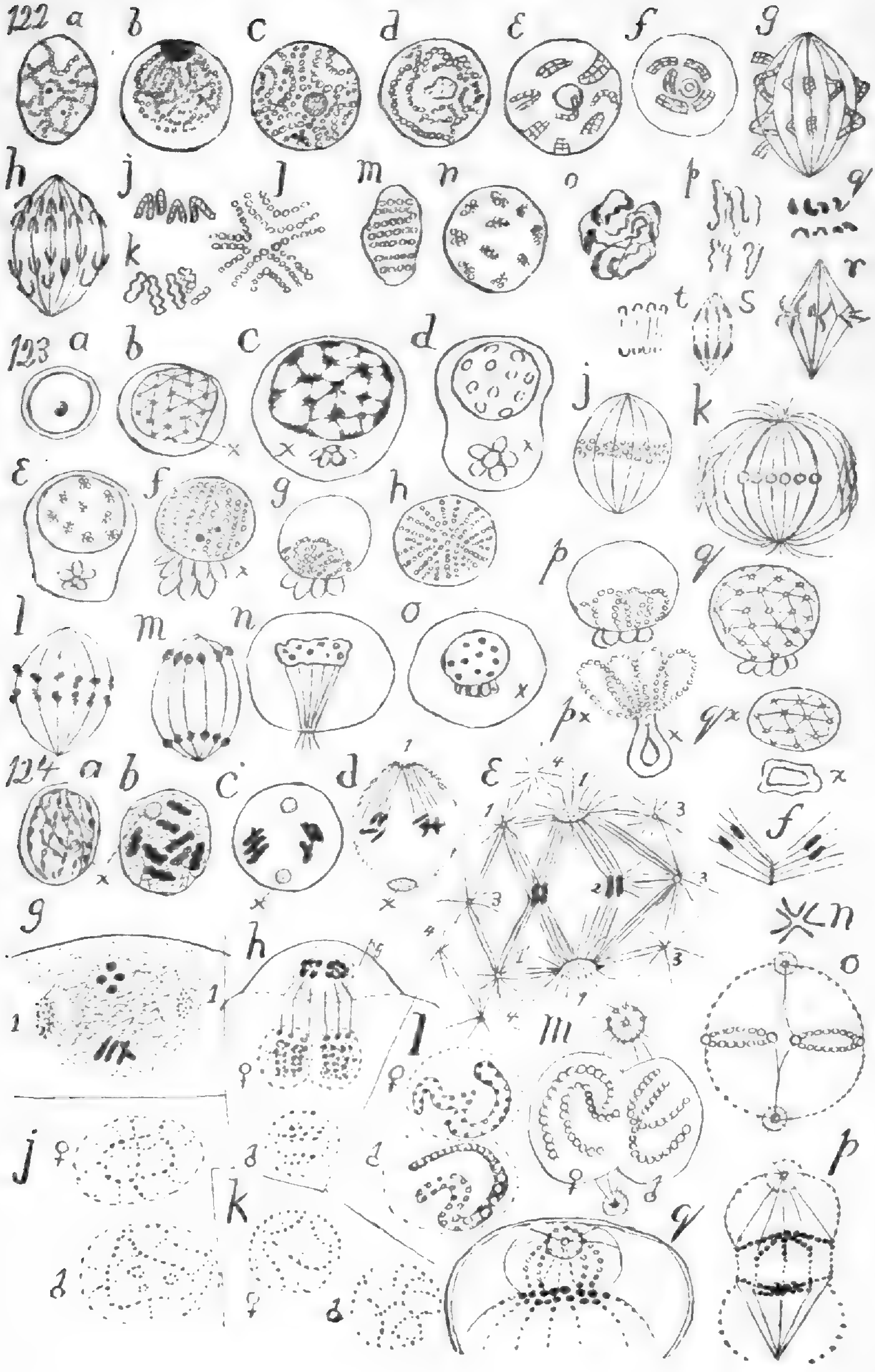


FIG. 120. Cell from testis of *Chelonia caja*—Carnoy, p. 250.—The nuclear spindle is nearly constricted off in the equator; the cytoplasm is partly so, and shows its fibres as regularly arranged as those of the spindle.

FIG. 121. Dividing sperm-cells from *Rat*—Weidersperg, A. m. A., xxv.—The two cells are at a distance from each other, but still the spindle-fibres unite the two daughter-nuclei.

PLATE VIII.

FIG. 122, *a–t*. From pollen mother-cells of *Fritillaria persica*—Strasburger, A. m. A., xxiii.—*a–g* is the prophase, *h–m* the anaphase, *m–r* a succeeding prophase, and *r–t* the next anaphase. The filament is at first much finer and more intricately woven than represented in the first three diagrams. In *b* we see a nucleolus at one pole in connection with which the loops of the skein are put; *c* is a polar view of the same. In *d* the filament has shortened more and passed out of its relation with the polar nucleolus, which is now breaking down. Next, in *e*, the segmentation is completed, and the limbs of the U-shaped segments are closely applied to each other; then, in *f*, these stumpy "loops" get crowded into the centre, and the spindle is formed (*g*). Then splitting ensues and metakinesis (*h*). In the daughter-nuclei the loops come to lie so as to make the poles of the nucleus unlike: side view in *j* and *k* and polar view in *l*, where the open ends of the loops point towards the old equator. Finally the daughter-nucleus is constituted as in *m* and *n* side and surface (polar) views respectively. But as it is about to divide again, the return to the resting state is not complete, immediately a continuous filament is established, with local thickenings on it, showing the chromatin already segmenting. While segmentation proceeds, the segments get into the meridians and shorten towards the equator (*p* and *q*), then the spindle is formed (*r*), and after the anaphase straight rods of chromatin pass to the poles, where they curve into loops (*s*, *t*). This series shows what variability there may be between successive divisions of same nucleus. Such variability has also been reported by the next (Fig. 123) and Carnoy (Fig. 124).

FIG. 123, *a–qx*. Spermatogenesis of *Helix pomatia*.—*a*, the nucleus, with a thin layer of protoplasm about it, forming the "sperm mother-cell." It is now homogeneous, soon becomes granular, and a reticulum is developed (*b*). Out of the nucleus now buds a paranucleus (*x*). Then there is a period of growth until we get *c*, with a rich surface reticulum of chromatin. In *d* the meshes of the reticulum have been absorbed by the karyosomata. In *e* each karyosoma has by binary segmentation formed four microsomata; these re-establish the net-work by separating to equidistant distribution, and, by retracting the connecting processes in some directions and strengthening them in a meridional direction, they form a series of loops of a filament (*f*). The paranucleus now approaches the pole, and at the same time the loops contract towards it, forming a rosette (*g*). The outer turns of the rosette break, as seen in polar view given in *h*. The paranucleus is absorbed, and the loops with their bends towards the axis move down to the equator (*j*); at the same time the spindle is formed. Here each loop shortens into a single karyosoma, forming fourteen to twenty such bodies in an "equatorial plate (*k*); the fibres of the spindle are in union, by means of the rays of the polar aster, with the cytoplasmic reticulum. Each karysoma now segments again into four microsomata (*l*), but only the first plane passed in the meridian cuts through completely; the second is simply the beginning of an attempt to form a beaded filament. These short filaments, consisting each of a pair of microsomata, now pass through the metaphase; but on their way the microsomata fuse to form the karyosomata of the daughter-nuclei (*m*, *n*). The spindle-fibres are utilized in forming the paranucleus (see A. m. A., xxvi.), the karyosomata segment to form the rosette *p* and *px*, where *p* is the figure in the first division and *px* that of the last. The reticulum is again established in *q* and *qx*; the steps following the final division are shown in Fig. 81, *a*, *b*, *c*, etc.

FIG. 124, *a–s*. "Cytodieresis" of the egg of *Ascaris megalocephala* (*a–g*), from Carnoy—La Cellule, vol. ii., May, 1886. *h–s* from Van Beneden, A. B., iv.—*a* is the nucleus of a young egg having a beaded filament forming a "skein." There is besides a nucleolus which Carnoy calls a "plasmatic-nucleolus" (*x*). Soon the filament segments (*b*) into eight karyosomata, and then the reticulum of the nucleus can be seen remaining. The egg grows, and when mature, and containing the spermatozoon, the preparations for forming the polar globules are made. The poles of the egg become marked each by a plasmatic-nucleolus; and the eight karyosomata now take an equatorial position in two groups (*c*), which gives to the germinal vesicle the appearance of having two germinal spots when viewed with moderate powers. The next stage shows the reticulum and wall of the germinal vesicle dissolved (which solution appears with all nuclei at this stage). Two groups of fibres now ray down from one pole towards the karyosomata (*d*). The other half of the spindle is soon completed in a similar manner. Then from the poles, where is a granular mass called a "plateau," there ray out into the protoplasm, fibres to form primary asters (1). The plateaux may split and so form several secondary plateaux, one of which is shown at 1′, Fig. *e*, for each pole, but its aster is still primary, because a part of its rays enter into the nuclear spindle. There may be several of these formed by repeated splitting of the "plateau." Secondary asters (2) are formed when the streamers flow from the karyosomata. Tertiary asters (3) are those connected with primary asters, but not a part of nuclear spindle; while quatenary asters (4) are small asters scattered through the yelk, but they may be connected with any other aster by one or two filaments. These asters are simply transformation of the ordinary reticulum, and no fixed law governs their production, and the utmost variety of combination may be found. The system of asters is much more complex in the formation of the second polar globule than in the first. Our description of Fig. *e* is from the second "caryocinetique figure." The asters finally fade out until only one plateau with its bilateral spindle is left; this often closes up on itself (*f*), so that the polar plate looks like an equatorial plate; the karyosomata are thus carried around into a plane at right angles to their old position, and tend to approach each other. But this mode of disappearance of the asters is only one of several. The last trace of the spindles and asters disappears (*g*), the plateaux are reduced to granular spots, the reticulum of the plasma is restored, but not as yet the membrane of the nucleus. Now the reticulum produces a simple spindle anew (the "spindle of separation") between the two groups of karyosomata, and the most peripheral one is cut off by an equatorial cell-plate, much as in plants (*h*). The segment cut off, which sometimes contains part of the yelk, is the polar globule. Then the four karyosomata of the yelk separate into groups of two each, and the process is elaborately repeated, so that only two karyosomata are left in the yelk to form the female pronucleus. The karyosomata in the polar globules may divide by karyokinesis. After the last polar globule has been extruded (*h*) the two karyosomata of the female pronucleus segment up into microsomata, and a similar figure is seen with the nuclein of the male pronucleus. *j* shows the two in a stage where a beaded filament is being established by concentration and shortening; *k* is a further stage; *l* shows the filament splitting in each pronucleus, but each first segments transversely into two; the pronuclei are closely applied to each other in a bilateral way, as seen by the position of the polar asters, which now appear (*m*). The loops finally arrange themselves in the equator, so as to show in polar view as in *n*; two of these loops were furnished by the male and two by the female. A side-view of this stage is shown in *o*, where the filaments have split in the middle, but not yet at the ends and the centre. In *p* the V-shaped loops have diverged towards the poles quite a ways; the central apices, however, move faster towards the poles than the outer limbs. *g* shows the microsomata somewhat irregularly segregated at the base of a figure formed by the polar aster and spindle of conducting fibre, and at the apex of the spindle of connecting fibrils, which is now constructing the cell-plate as in *s*. This seems to show that the *connecting fibres* and the *conducting fibres* belong to distinct systems, which is more clearly shown in *r*, where the karyosomata are placed at the cross-points of the meshes formed by the interlacing of the two systems. In the construction of the daughter-nucleus the microsomata pass by segmentation into a knäuel like that seen in *j* and *k*, and only when the equatorial plate is again formed for subsequent division do we get the four loops once more established, as is seen respectively at the left and right of *s*. Van Beneden, however, ignores the evidence of his own figures, and states that the four loops remain distinct throughout. (See text for further discussion.)

(*c*) KARYOKINESIS.

TWO extreme types of cell-division are known; in one, the nucleus simply constricts into two halves that move apart, followed by a similar constriction of the cell-body, so that each of the daughter-cells is provided with its own nucleus; in the other type the nucleus undergoes changes by which it becomes invisible to the microscope, unless the cell be treated with proper reagents, and as the partition which divides the cell-body appears, there is gradually built up a nucleus in each of the daughter-cells. The former type is known as *direct division*, the latter as *indirect division*. The term *karyokinesis* (nuclear motion) is usually restricted to the latter kind of division, but we are learning that there are many forms of indirect division that gradually unite the two extremes, so that we can no longer make the above distinction. The term karyokinesis admits readily of a broad signification, and we shall use the word as including all sorts of nuclear transformations.

Our knowledge of cell-structure and of the nucleus has wonderfully increased since 1833, when *Robert Brown* discovered the nucleus while studying the generative organs of orchids, and *Von Mohl* (1835) first saw it divide. To-day we are making as rapid progress in this direction as ever, and there is no field of biological research which offers so great inducements to the investigator, or so valuable results as this.

In all our progress there has been but one tendency, and that is to show us that the cell, and especially the nucleus, is a complex and highly-organized structure. We can no longer use the term *protoplasm* in its old sense of *one definite substance* whose remarkable properties are due to the great chemical complexity of its molecule.

1. *Historical.*—In the works of *Schleiden and Schwann* (1838–1840), which established the cell-doctrine, the cell was described as originating by the activity of the *cytoblast* (the nucleus), which was itself due to a condensation of granules in the cell-substance of the mother-cell. The endogenous origin of cells and cell-nuclei was, however, gradually overthrown, and in 1855 Remak established the generalization that all cells are due to the division of pre-existing cells in such manner that the nucleolus first divides, then the nucleus, and lastly the cell-body. This schema could rest only on the facts of direct division and a superficial observation of indirect division. As soon as the latter was carefully studied by *Hoffmeister*, in 1867, he found that the nucleus disappears and two centres of attraction arise in the cell, in connection with which the daughter-nuclei were built up. These facts had been observed in animal-cells already in 1858, by *Munk*, so that the view that a cell must return to a cytode condition to divide and so, in a manner, be rejuvenated, and produce new nuclei endogenously, was fairly established. This school was strengthened by receiving the support of all who had observed the maturation of the ovum (except Warneck, 1850), for here it was seen that the germinal vesicle disappears before segmentation, and that the nuclei of the segmentation products arise as new structures, and, moreover, *Valette St. George* had, in 1866, shown that the ovum is a cell, the germinal vesicle a nucleus, and the germinal dot a nucleolus.

The complex nature of cell-structure was surmised by *Brücke* as early as 1861, although the microscope had then only revealed granules, and that these were at times arranged in a radiate manner with reference to the nuclei.

In 1865, *Frommann*, through extended research, described the reticulate nature of protoplasm and generalized that this was the typical structure of protoplasm, but his views remained for many years unnoticed.

In 1873, *Heitzmann* advocated the view that whenever a protoplasmic mass was fully developed it became vacuolated, and so showed a reticulated structure in which the nodal points appeared as granules. The nucleus is only a large nodal point in the centre, and as this developed it repeated the process, and finally the nucleolus in a mature cell takes on the reticulate structure. He laid the basis for Nāgeli's theory of heredity by advancing the notion that the reticuli of all the cells in the body are continuous, and so anticipated modern studies of protoplasmic continuity.

This year is memorable as marking the beginning of studies on karyokinesis. The stimulus came from a paper by *Schneider*,[1] in which the different phases were pretty well described, though their connection and sequence were unknown. Even the spindle and cell plate were figured. *Bütschli* and *Fol* confirmed these results, the former mainly as to the nuclear rosette and its separation into two halves to constitute the daughter-nuclei, while the latter got the asters and spindle best; hence the former agreed with Schneider that there was no deconstitution of the nucleus, while the latter inclined to side with the orthodox school.

Auerbach now appeared with his "Organologische Studien" (1874). He starts with Heitzmann's views as to the organization of protoplasm, but considers the nucleus to be a sap-cavity into which molecules of protoplasm wander and grow to become nucleoli. These multiply by division, so that old cells have many nucleoli. The cells of highly-organized tissues, he says, have more nucleoli than cells lower in the scale of organization. The nucleoli are young cells, and they are simply separated into two groups in direct division; but in indirect division, which he distinguishes as *palingenetic*, these are dissolved into a molecular state in the nuclear sap, and then absorbed with the sap by the cell-plasma. This process is termed *karyolysis*, the spindle with its polar asters is the karyolytic figure and the simple expression of the streaming out of the nuclear substance. Later, near each star, the sap and molecules return to form a daughter-nucleus. This seemed a pretty fair explanation, and *Flemming* at this time was much influenced by it.

Bütschli, however (1875), opposed the theory, though he modified his former view of the simple persistence and division of the nucleus to the view that the nucleus is *reconstructed* into a spindle, at whose equator the fibres become thickened to form the nuclear plate, which plate by splitting passed its halves to the poles of the spindle to be re-formed into nuclei. In the same

[1] A list of the papers referred to will be given at the close of the article.

year the first edition of *Strasburger's* work on cell-division appeared. This treated in the main of the plant-cell, where the spindle thickenings after separating leave between themselves connecting fibrils that are more prominent than in the animal-cell. These he called *nuclear fibrils*, and at their equator a second set of thickenings appear that go to construct the dividing wall between the new cells, hence he named it the *cell-plate*. The second edition of this work appeared in 1876, and the third in 1880. In the last he changes the name he gave the connecting fibres to *cell-fibres*, because he supposed that they were formed from the cytoplasm penetrating into the nuclear matter at the time of the deconstitution of the latter.

Van Beneden, on the other hand, agreed with Bütschli that the spindle comes from the old nucleus. He distinguishes between the nuclear *sap* and the *nuclear essence*. The connecting fibrils are of the same essence as the nuclear disk, and are due to the drawing out of the elements as they segment into the daughter-disks.

In this year, also, *Hertwig* showed that the egg-nucleus does not disappear during cleavage, but passes through a metamorphosis similar to the cell-divisions described by Bütschli. At the poles of the spindle and in the centre of each aster he finds a *polar corpuscle*. Fol had seen corpuscles in the stars, but had confounded them with the daughter-nuclei. The following year, 1876, Fol corrects this error. *Balbiani* found the nuclear plate to be composed of *rod-like elements* that were composed of *granules*, but these views were unnoticed, so that *Pfitzner* received the honor of their discovery five years later.

At this time the elements which compose the nuclear plate were not distinguished from the spindle-fibres, due to the fact that reagents which made the one visible left the other obscure, hence there was a good deal of contradiction in the results, which was unreal.

In this year *Bütschli's* chief work appears. He supposes the infusorian nucleus to represent the original type of nucleus. He thinks the cytoplasm stimulates the nucleus to division, though it may not itself necessarily follow the example. The rays of the stars are not the expression of attractive forces of the nucleus, but are rather due to a chemical influence. He found that the asters when they first appear near the nucleus, are not necessarily at opposite poles. R. Hertwig had divided the nuclear matter, like Van Beneden, into sap and nuclear substance, *Strasburger* now proposes the following scheme. There are in the nucleus three formed substances, one of which is active. By the excitation of the cytoplasm the active substance gathers at the poles of the nucleus, leaving the spindle-fibres stretching between; the latter are cytoplasmic in origin, and the polar substance acts on them just as it acts on the fibres of the cytoplasm which form the stars, hence the general disposition of the polarized molecules in rows radiating away from the polar area. The third substance is first repelled from the poles to form the nuclear equatorial plate; but in some way there is a change of polarity by which it is subsequently attracted to the poles, and so the plate splits in two (it might also do this through internal repulsion, but, as we shall show farther on, there is no necessity for a physical explanation). This is perhaps the best of the few theories which have been advanced to account for the phenomena.[1]

On the question of the solution of the nucleus, *Fol* now took a middle ground, holding with Strasburger that the cytoplasm entering formed the spindle, but the nuclear matter simply became continuous with the cytoplasm through the dissolution of the nuclear membrane.

In 1878, *Schleicher* advanced the view that the protoplasm was composed not of parts that had a fixed relation to one another, but of units that were independently mobile, and so all the structures were amœboid in form, hence there could be no definite phases during cell-division, wherefore he proposed the term *karyokinesis* to designate the phenomena. On the other hand, *Flemming* had, by careful staining, worked out the series of forms through which the nuclear matter passes during karyokinesis. He did not get the spindle well because, as he showed the next year, this was composed of non-stainable matter. The resting nucleus consists of a vesicle enclosing a reticulum and one or more nucleoli. This reticulum is changed to an exceedingly long and intricately wound filament, at the same time the nucleoli dissolve in the sap and the filament absorbs the material. This is the phase of the *close knäuel.* (Fig. 112, *a.*) The filament now shortens and grows thicker, passing through the open

[1] We give the theory in its most developed form, third edition of Strasburger's work, 1880, where he slightly modified it from its original statement in the second edition.

knäuel stage, until it shows as a *rosette* (Fig. 111, *e*), with loops turned peripherally and towards the centre. Then the outer limbs of the loops break, leaving a lot of V-shaped filaments having their apices towards a common centre. (Fig. 105, *f*.) This is the "mother-star." Meanwhile the central point of attraction splits and moves to the poles, where asters now appear. This is accompanied by alternate expansion and contraction of the nuclear star (diastole and systole), and finally results in its flattening into an "equatorial plate" (Fig. 113, *d*); then each loop splits lengthwise, though it may have done so while still in the mother-star (Fig. 119, *e*), and thus formed the "fine-rayed star." The halves of each loop become separated and grouped in a "dyaster," or two daughter-stars, passing through the phase which shows as a splitting of the equatorial plate. Then the apices of the loops (travelling along the spindle-fibres) are drawn towards the poles (Fig. 112, *e*), drawing the limbs after them, and so reach the pole. Here they form into a figure like the old mother-star (Figs. 112, *f*, 105, *h*), and return, by uniting ends through the rosette (Fig. 118, *f*) into the knäuel form, and finally become like the mother-nucleus.

The next year Flemming divided cell-division into *direct* and *indirect*. He limited the former to motile cells, and accepted Schleicher's term as applying to the indirect kind. He thinks the nucleoli are an accidental thing in a nucleus, and according as nuclear substance stains or not he calls it *chromatin* and *achromatin*. In the same year, 1879, Fol proposed his electrolytic theory of cell-division. He believed the nuclear reticulum was directly transformed into the spindle, and the nuclear plate was due to an equatorial thickening of its fibres.

Strasburger's studies gave him different results from Flemming. In plants the phases are not so marked, but may give a spindle figure of chromatic granules arranged in rows like the staves of a cask; and the daughter-nuclei arise through the simple breaking of these across the middle. (Figs. 115, *a–d*.)

In 1881, *Retzius* had confirmed the phases of Flemming, but showed that the rosette must be given up, as segmentation of the knäuel may take place while in the loose or open knäuel stage. (Fig. 112, *b*.) He says the chromatic substance is contained in a hyaline matrix, as Pfitzner has shown, and most of it is absorbed by a particular node or nodes, and these are the nucleoli.

Pfitzner, this year, called attention to the fact that the nuclear loops are composed of granules like a row of beads, and that the loop splits by the segmentation of each granule. He thought these granules to be the protoplasmic molecules, but later (1883) said they were independent and individual units in the nuclear structure. (See Fig. 114, *a*, *b*.)

In 1882, Strasburger proposed the terms *cytoplasm*, *microsomata*, *nucleoplasm*, etc., which we adopted in Section *a* of this paper. He studied more carefully the method of rearrangement of the loops in the equatorial plate during its division, and finds that it is more complex than Flemming made it, for the old bend straightens out, and one end of the loop gets drawn towards the pole, and then bends like a hook, and this new bend travels along the filament to its middle point, thus making the two limbs equal, while at the same time the loop is drawn polewards. Strasburger had not yet discovered the splitting of the loops, so that he had as yet only an imperfect notion of how the rearrangement took place. (See Figs. 118 and 119 for the actual facts.)

In this year appeared *Flemming's* systematic work on the cell, and in it he accepts the criticisms of Retzius and Strasburger, so far as they relate to the rosette phase and the "rearrangement." He doubts if there is a reticulum in cells, or at least in nuclei. The appearance may be due to the optical effect of a closely-wound filament or *mitom*, the sap is the paramitom, and karyokinesis should be termed mitokinesis, or mitosis. Besides the mitom there are chief and accessory nucleoli. He gives up the idea that the chromatin may dissolve in the cell-sap. He gives us the term *spirem* for the knãuel phase. Rearrangement in the equatorial plate is termed *metakinesis*. He uses the term aster for the star-form of the mother-nucleus, and dyaster for that of the daughter-nucleus.

In 1883, *Pfitzner* makes three sorts of chromatic substance in the nucleus. The substance of the spindle, hitherto called achromatic, he terms *parachromatin*, while the sap only is true achromatin. The nucleolus has *prochromatin*, while the mitom has the true chromatin. In the resting nucleus there may be, besides Strasburger's membrane, which belongs to the cytoplasm, a true nuclear membrane of parachromatin.

Roux, in this year, proposes a theory of karyokinesis, based on the idea that there is a mixture of qualities in the chromatin, etc., and that these have to be distributed in a definite way between the daughter-cells at each division. Hence the complicated machinery.

In 1884, *Rabl* seeks to show that there never is a simple filament in a cell, but that the loops pre-exist even in the resting state, and that in this latter state the chromatin flows out along definite paths into finer and finer branches, which never anastomose, but may swell up at points, where a special lot of chromatin gathers, and there form nucleoli. The cell is heteropolar, always having the apices of the loops directed towards the principal pole. (See Fig. 113, *a–f.*)

Heuser agrees with Rabl in finding the mitom segmental in the resting phase.

In this year *Strasburger* discovers the splitting phase in certain plant-tissues. (Figs. 118, 119.)

Carnoy now comes to the front with important contributions. He finds, what has not been noticed by previous observers in its true light, that there exists a true reticulum in the nucleus, like the reticulum in the cytoplasm (Fig. 4), but that the mitom in its convolutions hides this, and gives us the aspect of a coarser reticulum (Fig. 3), which is the one referred to by previous investigators. The mitom may be itself reticulated (Fig. 13), or its segments be short and rod-like in some cells (Figs. 123, 124), but besides these there are the nucleoli. All the nucleoli are not composed of true chromatin. There are one or two that are composed of *plastin* (Figs. 44, 124, *b, c*), like the true reticulum, and with it and the membrane become transformed to the achromatic or spindle part of the figure. The phases of Flemming are realized only in a limited number of cases, and there appears to be the utmost variety in the karyokinetic figures; we may get forms where the nuclear reticulum does not become transformed, although the mitom may segment. (Figs. 109, 110, *stenotic division.*) Again, the achromatic part of the figure may in one and the same cell differ under different circumstances from great complexity to simplicity of structure.[1]

Platner has also made important contributions (see Fig. 123, *a–qx*); but these will be considered in another connection.[2]

[1] See also, Lee, "Carnoy's Cell Researches." Q. J. M. S., April, 1886.

[2] The latest paper by Platner (see Bibliography) has just come to my notice. Platner thinks the spindle fibres are one continuous filament in which is a proto-

Thus we get a notion of the cell as a most varied organism. Cells may be as varied among themselves as the higher organisms. But we have hardly begun to get an idea of the variety of karyokinetic phenomena; what is to appear by future study we can only vaguely imagine. The phenomena of cell-division cannot be purely physical phenomena. They are living phenomena, and show they are subject to the laws of heredity and evolution of adaptation and variation. If this be so, we can understand karyokinesis only through comparative studies, just as we study the laws of variation and evolution, of homology and affinity with higher organisms. It becomes important, therefore, to understand karyokinetic phenomena among the Protozoa. Recent studies in this line have shown that here we may get nearly as complex figures of karyokinesis as in tissue-cells; but from this we get all grades down to the simplest direct division. We learn that nuclei may be alike in distantly-related forms, while closely-allied forms may have very diverse nuclei.

2. *Protozoa.*—These organisms present, as we should expect, a great variety of nuclear forms and karyokinesis. The differentiation has been in so many different directions, with the acquirement of secondary characters whose physiological significance we can hardly guess, that it is perhaps impossible to connect the forms. Frey thinks the vesicular form of nucleus is the primitive one, but most writers agree with R. Hertwig in deriving this form from a solid form through vacuolation of the latter, which leaves the chromatin either all in a cortical zone, or else in one or more nucleoli; and this process may be repeated in a nucleolus when this becomes large and important. Gruber suggests that in a primitive state the chromatin was present throughout the cell in a granular form, as in Trichosphærium, Pleurophrys, Trachelocercus, Chœnia, and others, and that solid nuclei arose by fusion of these granules, or by some of them remaining in close union following their multiplication. But it must be observed that this granular condition could easily arise by the segmentation of larger bodies and so be secondary in

plasmic streaming in one direction. Each meridian bears a karyosoma that splits, because the fibre splits; thus, always in a meridional plane. The parachromatic mitom is so wound that the current is towards opposite poles in neighboring fibres after the splitting, hence the daughter karyosomata are swept to their proper poles. This theory appears to be as weak as its predecessors.

character. In some forms we get either many small nuclei or else granules, besides one or more chief nuclei, and, according to Altmann, this is true of all tissue-cells, so that we have nuclear bodies first differentiated in two directions, the granules serving some nutritive or other function, while the nuclei retained the office of being the primary reproductive bodies.

The next differentiation arising would be the differentiation of the nuclei into two kinds, which in some Ciliates have acquired considerable independence and act quite differently during division. We know them as nuclei and nucleoli, or as nuclei and paranuclei, respectively. Better terms are Huxley's *endoplast* and *endoplastule*, as not implying homologies which are probably false. In massive nuclei the chromatin exists in a fine net-work, which gives the appearance of granules in the resting phase and of fibrillæ during division. In Gastrostyla the endoplastules divide by a true spindle and a nuclear plate of karyosomata. Nearly all the nuclei of Opalina are of this sort.

The substance of the nucleus may differentiate into two sorts that gather in two portions of the nucleus, either by polar differentiation or by centripetal differentiation. One substance is hyaline, the other granular; examples are Leptodiscus, Spirochona, and Noctiluca. In Spirochona it is the endoplast which has this structure, and it divides by a complex kinesis. A nucleolus appears in the clear part, which becomes transformed into fibrils while the hyaline portion gathers as two polar plates that separate, and so, as it were, tear the nucleus in two. The three endoplastules present divide by simple constriction at the same time; and here also there are polar plates of a substance different from the equatorial portion.

In a different direction we get the vesicular differentiation, and this is most common in the lower Protozoa, and is that from which the metazoan cell-nucleus is derived. In Rhizopods we may not only get many nuclei (about two hundred in Pelomyxa), but each nucleus may present a great variety of phenomena. There may be a central nucleolus, and this nucleolus may be composed of many microsomata, or the microsomata may separate as so many nucleoli, or again may fall into granules. Together with all these forms there may be a cortical shell of microsomata, for examples, see Figs. 14, *a*, *b*, 20, 22. The multinuclearity of many of the Protozoa is due to the fact that cell-division is purely facultative, and has not been inseparably associated with nuclear division. When it takes place, as in Opalina, any number of nuclei may be separated away in the daughter-cell. In many cases the nuclear divisions affect only the chromatin, while the hyaloplasm and its nucleolemma remain as *funiculi* uniting the segments. (See Figs. 42, 31, 29, 28, 41, etc.) The microsomata of a nucleolus or of a karyosoma behave in the same way; as in Figs. 19, *d*, 43, 114, 115, 123, *g*, 124, *o*.

In Radiolaria we get a multitude of small "massive" nuclei that divide by amœboid constriction (Fig. 25), and in the central capsule vesicular nuclei, whose different metamorphoses are shown in Figs. 16, 17, 18, and 19.

In division of vesicular nuclei we get, as the simplest form, the Remakian scheme. (Fig. 100.) Next we may get the granular contents arranged in fibrils that are bisected by the constricting nucleus (Fig. 101), or they may remain in the granular state. (Fig. 99.) The most complex case is given by *Actinosphærium eichornii*. (Fig. 103, *a–q*.) Here the nucleolus separates into two bodies, one containing chromatin and one the parachromatin; then each body segments into fine granules; these granules get arranged in fibrils; the chromatin-granules fuse to karyosomata lying in an equatorial plate in the spindle formed by the parachromatin; the karyosomata divide into daughter-karyosomata that pass towards the poles; on its way each daughter-karyosoma segments to microsomata; the microsomata segment to granules, which, however, form separate karyosoma-like masses until they are absorbed by the polar plates. The latter are due to the fact that the external protoplasm had gathered at two opposite poles of the nucleus and had attracted the parachromatic cortical layer of the nucleus. Why the protoplasm should gather at the poles and so induce nuclear division is unknown. Possibly substances in the nucleus have first passed to the poles and attracted the cytoplasm. These substances may be the segments of the paranucleolus, for it is possible to derive the spindle-fibres from a differentiation of some of the chromatin-granules into hyaloplasm.

It is rare to find the nucleolus (or the granules that represent it when it is segmented) in the same condition during nuclear division as during the resting phase. There is a cycle of changes, so that one condition has to be assumed for division, and then the chromatin returns through inverse stages to its resting state.

The phases of this cycle may be few or they may be many, and besides, the phase in which the nucleus rests may be in one case in one point of this cycle, in another it is a different phase of this cycle. *But in all cases the cycle is made up of stages of fusion or of segmentation between the two extremes of one single nucleolus and of numerous granules.* (The law is unchanged even if we suppose that the granules are the nodes of a reticulum.) Usually nuclear division follows that point in the cycle where the chromatin is most condensed. Thus, even in the Remakian schema, this law is followed, as see Figs. 99, 100, 101. *Cases like Figs.* 101, 103, 104, *and karyokinesis in Metazoa are related to the Remakian schema by a compounding of the latter, for each karyosoma follows the Remakian schema.* We thus see that direct division is to indirect division as a unicellular or unisegmental animal is to one that is multicellular or multisegmented. *If we study the cell-division of multinuclear Protozoa we find that the same laws hold.* Opalina is an exception, and such forms as Polykrikos (Fig. 96), that have only nuclear division during cell-division, are connecting links to the far larger class of cases, where, as in Oxytricha (Fig. 95), Paramœcium (Fig. 97½), Stentor, etc., there is fusion of the nuclei (or of nuclear segments in moniliform endoplasts) before division and multiplication of these bodies preceding, during, or following division. In Paramœcium the resting phase concurs with the mononucleate phase. But even in the exceptions to this law there is fusion, when these forms encyst to produce spores (Fig. 97) by the successive or by simultaneous division of the fused nucleus. In such cases, as in conjugation of low forms, the phenomena may be facultative, the number of nuclei resulting from the fusion being one which varies from one to the original number, just as the resulting spores may vary in number.

What is the meaning of this? *It is evident that we have here to do with conjugative phenomena.* These self-same nuclei that with one form of cell-division fuse, may, in case of buds, be set free, as microgonidia to fertilize other gonidia. It may be that the granules and nuclei are in different parts of the cell subjected to different conditions, and thus come to vary slightly. If, now, the cell divided, the daughter-cells would differ, and ultimately new species be formed. But, as we find that if conjugation phenomena be left out in one place in the different modes of reproduction it is apt to occur in other points of the cycle, and if prevented, as in male and female parthenogenesis, the resulting organisms are weak, we must conclude that the organism derives some benefit from the mixture of chromatins that are slightly different. In the case assumed above, where cell-division is not accompanied by fusion of the nuclei, we may presume that conjugation of gametes supplies this lack,[1] though in Opalina the only form of fertilization as yet discovered is that of nuclear fusion during encystment. But Opalina is a parasite, and parasites, we know, get along remarkably well without fertilization.

This explanation of karyokinesis seems quite plausible, so that we may formulate the law *that every cell-division is preceded by fertilization phenomena: is accompanied by close inbreeding.* Other explanations have been suggested. Strasburger regards karyokinesis as resulting in like cells, therefore the different chromatins present must be carefully divided, so that each daughter-cell shall receive its proper ingredients. Roux and Weismann go further and call attention to the fact that dividing cells are not alike, so that we need a particular distribution of the gemmules for each division, so that, to follow the last author, in the first egg-segmentation, the histogenic plasm is separated from the generative plasm. Thus the soma is descended from one blastomere and the generative cells from another. In a similar way the endoderm-cells have a common ancestor, and the ectoderm another, and so on. This explanation seems to me difficult of application to the Protozoa, so that the law enunciated above appears to be unaffected.

3. *General.*—It would extend the length of this paper unduly, as well as be of no interest except to the specialist, to discuss the various views that have been advanced in interpretation of the special stages of karyokinesis. Nevertheless, some of the more prominent features should be noticed. We have already seen that cell-division need not be necessarily associated with nuclear division, whether this be direct or indirect, so in the higher tissues there occur cells that present such conditions. These are the internodal cells of Chara, many fungi where the nuclei are granules, and the generative tissues of both plants and animals; also in cartilage-cells and marrow-cells. In the generative tissues of plants cell-division does not take place until many endosperm

[1] The formation of varieties and species must take place in spite of this tendency of differentiated chromatins to fuse.

nuclei are present, and to this form of division the term *free-cell formation* has been applied, while the term in the sense in which Schleiden used it has been pretty nearly abandoned. Still, we saw that in the Protozoa nuclei could arise by the fusion of granules, and return by fragmentation to the granular state, and it may be a question whether similar phenomena may not be found in tissue-cells. The cases of the endogenous origin of nuclei are reported in eggs that have so much yelk that it is hard to follow the nuclear changes.

Does the cytoplasm or the nucleus stimulate division? Hertwig holds that the nucleus is the automatic centre which controls the individuality of the cell, but it must be confessed that the earliest changes are in the cytoplasm. Protoplasm gathers at two points and forms stars, between which the nucleus becomes stretched out and transformed. Carnoy (Fig. 124), and lately (1886) Hertwig, have found independent stars arising in the cytoplasm, and if more than two of these get connection with the nucleus, there are as many poles and spindles or resulting daughter-nuclei as there are asters. The rays about these asters are simply a transformation of the reticulum. What their function is we can only guess with the numerous guesses made by predecessors. They may be nutritive, may be paths for travelling gemmules, may have a nervous function, or finally only serve motor functions. The spindle-fibres are a similar transformation of the nuclear reticulum (*i.e.*, the parachromatin reticulum); whether the nuclear membrane in dissolving adds to their material, or gathers at the poles of the spindle as in Actinosphærium, may be doubtful. In the latter case it would continue its original function of mediating between the intra- and the extra-nuclear reticulum. But Strasburger and others find that the astral- and spindle-fibres are continuous, and thinks the latter come by a penetration of the former through the poles of the nucleus. But the mass of evidence is against him, and besides, the spindle-fibres are composed of parachromatin (chemically, *plastin*) and react differently from the extra-nuclear fibres.

Then there are the polar corpuscles in the centres of the stars, and forming the apices of the spindle. Their origin is obscure. Possibly the plastin nucleolus of Carnoy may, by its division and migration, have initiated the division of the nucleus, and is represented in these corpuscles. It is certain that these corpuscles may divide, and so split the spindle (Fig. 124), and often the two stars first arise close together, and move later to opposite poles. We must also notice Rabl's discovery of a spindle intact in the nucleus, which rotates into its position (see Fig. 113, *c*) through an angle of 90°.

In what condition is the chromatin in the resting nucleus? It may be present as a fine or as a coarse reticulum, closely interpenetrating the parachromatic reticulum, and perhaps fused with it. In the germinal vesicle it is present as a nucleus, which becomes transformed into the reticulum before division. The next change this reticulum suffers is its transformation into a mitom,—*i.e.*, a filament,—which, while it is very long and closely balled up, may not be distinguished from a reticulum. Some nuclei rest in this phase, or in subsequent phases of its shortening and consequent thickening. When thick it has been found to be composed of granules that fuse to form microsomata, so that finally the mitom is one microsoma thick. The next phase is one in which the mitom segments into loops or filamentous karyosomata. Some cells rest in this phase. (See Fig. 124.) When the segmentation occurs early, while the reticulum is being transformed into the mitom, we get a condition of things represented in Figs. 113 and 45. The karyosomata are apt to be short or corpuscular in generative cells. (See Figs. 122 and 123.)

Now we have two ways in which the karyosomata are separated into two groups to form the daughter-nuclei. In one they are separated without accompanying division, as in Fig. 124. In the other they divide in such a way that each half of the karyosoma is destined to pass into different daughter-nuclei. In this case we get two forms. In one form the karyosomata, if they are short, become arranged into a nuclear plate in the equator of the spindle, and by division and separation of the halves we get two daughter-plates that pass to the poles, and become the daughter-nuclei, but if they are long, they lie along each spindle-fibre and are bisected in the equator as in Figs. 101 and 115. In the other case the daughter-segments are produced by a longitudinal splitting of the loop, as shown in Figs. 114, 118, and 119, in which splitting usually occurs early, while the spirem figure still persists, and in this case no true equatorial plate may form, but be only the expression of separating loops passing each other on the way to their respective poles. Between all these different methods there are connecting links. Carnoy calls such a case as is seen in Fig. 109 *stenolic* division, while similar separation with more complex spindle and asters, as in Fig. 124, he terms *cytodieresis.*

Finally, the karyosomata reach the poles and pass through stages of fusion of the larger bodies and segmentation of the smaller, so that the nucleus appears homogeneous because of its very fine reticulum. Then from this point the changes continue along the upward path to the resting phase, wherever that may be. While undergoing this fusion, the hyaloplasm in which the chromatin-granules are imbedded become much increased, so that if the chromatin is sparse we get vesicular unions, like Fig. 125. This hyaloplasm is parachromatin, and it undoubtedly enters partly into the formation of the spindle-fibres; in Fig. 126 appears to be the only source of these.

Concerning the nucleoli that may be present, besides the reticulum or mitom and the plasmatic nucleolus, there exist the most diverse views. In the first place, we must call attention to the fact that very diverse structures have received this name by different writers. The nodes of the reticulum, the karyosomata, the groups these may form when unresolved by the lens, all have received this name. The true nucleolus seems to disappear during division, and to be gradually built up by fusion of granules at its close. It has been supposed that it dissolved in the nuclear sap, and was absorbed by the mitom, or that it was directly connected with the mitom, and so incorporated into it. Thus Pfitzner called its substance *prochromatin*, as being a store from which the mitom replenished itself, but has lately changed the name to pseudochromatin, and other authors think it is of accidental value. Those who think with Strasburger, Fraisse, Kassel, and Brass that the chromatin is food-substance and the hyaloplasm the real idioplasm, find no difficulty with this body. But it must be remembered that it also has hyaloplasm, so the difficulty is unsolved. What is the meaning of those polar corpuscles (not to be confounded with the polar corpuscles considered above) seen in Fig. 112, *c, o, d,* which multiply as the loops multiply, and whose number is approximately two or three times that of the loops? It almost seems as if they were related to the karyosomata, as the endoplastules of Protozoa are to the endoplasts. They may have come by the segmentation of the nucleolus, and in that case this body is a paranucleolus over against the mitom. But these bodies may have come from the plasmatic nucleolus of Carnoy, and so we are still in doubt.

Another unsolved problem is concerning the connecting fibres that remain between the retreating karyosomata. In plants they help to build the cell-plate, and the nucleus gets reconstructed without their being absorbed. In animals they seem to be absorbed, for, if left outside, they form the paranucleus of Platner (see Fig. 123), which is later absorbed by the nucleus to form the spindle. They are thus made of substances similar to those which enter into the parachromatic reticulum, and, when not absorbed by the nucleus, they join the other fibres of the cytoplasmic reticulum, from which they can no longer be distinguished. Thus the chromatin of the nucleus must make more hyaloplasm, from which a new parachromatic reticulum can arise.

There is some evidence of the existence of microsomata that are not chromatin; in the cytoplasmic reticulum these are not so active in their fusions and segmentations as the nuclear microsomata, but still they do this, for the spindle-fibres and rays, when extra-nuclear, have been observed to segment and fuse. This can easily be understood by combining with Heitzmann's schema the idea of units in the cell. Strasburger and Pfitzner recognize the microsoma as such a unit, and we have shown that there are numerous units of differing complexity and degrees. When two organisms differ in the number of units that enter into their structure, such difference is one of degree in the ordinary sense, but when two organisms differ by belonging to higher or lower stadia of organization, such difference constitutes a *discrete degree.* Such degrees separate the Protozoa from Metozoa, a man from the social organism, a cell from the microsoma, a microsoma from a gemmule. Though here further study is needed to discover the number of stadia visible to the microscope, Nägeli has admirably discussed the stadia that lie between the chemical molecule and the micellæ, and Altmann has suggested that the bacterial organisms are of the same grade of organization as the microsoma. *Each node in a reticulum may be conceived as a unit.* We have already seen how, when chromatin segments, it may leave a funiculus of hyaloplasm (with or without a wall). This connecting piece of hyaloplasm may break by being drawn towards the centres on either side of it, or it may, like a pseudopodium, reach out and obtain a fresh connection with a neighbor. This is admirably illustrated in Fig. 123. In this way it is *that a reticulum can be transformed into a mitom or a fibre.* The observations of Rabl and of Retzius on the formation of the mitom become intelligible. By the attraction of the hyaloplasm along definite paths, and their separation along others, we may also see how a nucleus arises in a cell, as in Fig. 2. By mutual attraction the microsomata fuse. Why they segment may be explained by assuming that certain gemmules or societies of gemmules differentiate from the others and serve as governing centres, about which the rest flock. Individuality arises in this way everywhere. The cause of union between two units of like order, which constitutes sexual union, is not so apparent. We find this occurring only where a slight difference has arisen, so that, Lankester says, "they may mutually gain each other's experience." At bottom all the phenomena of the cell-life may be referred to attractions, and through its action the reticulum becomes the organ of movement.

There is considerable evidence that successive cell-divisions differ in their karyokinetic phenomena. We know that the number of karyosomata in the segmenting-egg are fewer than in the tissue-cells, and that they are shorter. There must be a change somewhere. But in gametogenesis two successive generations may differ, as can be seen by Figs. 123 and 124. We may start in gametogenesis with direct division, pass on to generations produced by budding or by stenosis, and finally reach the complex phenomena of the segmenting embryo. We know only a little about this. Our knowledge compares with what we should know, as the knowledge of zoologists, before embryology, compares with their present knowledge. When we reflect that we must observe cells in all periods of their life and all the generations of cells as they differentiate, and we must do this for all the different animals, and the results must be corroborated by different observers, morphologists need not quarrel for lack of room nor sit idle for lack of work. We can also understand why karyokinesis is such a mysterious phenomenon. *Cell-division must be understood ontogenetically and phylogenetically.*

(To be concluded.)

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

For twenty years the American Naturalist has played an important part in the history and development of American science. In the seventeen thousand pages which compose the twenty volumes there is contained not only an epitome of the world's scientific progress but a large proportion of the original investigation carried on in this country. The magazine has won for itself an honorable place in the scientific literature of the world, and to-day its position is higher than ever before. Through these twenty years it has pursued but a single policy, and in its fundamental features it is, in 1887, the same that it was in 1867. It has constantly aimed to make American natural history prominent, and to occupy a happy medium between a technical magazine and one in which all science is sacrificed to popularity. It has aimed to instruct rather than to amuse; it has sought accuracy rather than elegance of diction. Throughout it has aimed at independence, and its columns have ever been open to all. There have been many changes in these twenty years, but these have been in way of expansion, rather than alterations of the original plan.

In mere size alone the development has been considerable. The volume which has just been closed contained nearly twice the matter that was given twenty years ago. Then fifty writers contributed notes and longer articles to a single volume, now the contributors number nearly one hundred. In the beginning there were four editors, now the editorial corps numbers nine. In the first number the minor notes were grouped under the heads of Botany, Zoology, and Geology. To-day it has, besides these, departments of Anthropology, Embryology, Entomology, Geography and Travels, Microscopy, Mineralogy and Petrography, Physiology and Psychology, as well as one embracing the miscellaneous scientific news of the day. All of these facts show progress, and apparently a growth in the right direction. They indicate that the magazine had friends and has made more friends; and to all these, both subscribers and contributors, the American Naturalist returns its most cordial thanks. In the past the editors and proprietors have endeavored to show their appreciation of public favor by increasing the size and improving the quality of the magazine. There is still room for improvement, and it is confidently believed that the present volume will surpass any of its predecessors, a belief that seems warranted by the reputation of the J. B. Lippincott Company of Philadelphia, which has assumed the business management. The enterprise shown by this house in other lines is an ample guarantee that in all that pertains to the mechanical execution the future volumes will be better than the past. It also ensures a wider field of influence and a larger circulation, and this, in turn, will result in still further improvements.

With the present volume there is a change in the editorial management. Professor A. S. Packard, to whom is due the credit of starting the magazine, and who has labored unceasingly for its success for twenty years, retires from the management. He has won the thanks of every lover of Natural History, and has fully earned the relaxation and release which his retirement will give him. Certainly no one has done more for the spread of a knowledge of nature than he. His place will be taken by Dr. J. S. Kingsley, of Malden, Massachusetts, who needs no introduction to the readers of this journal, and who prefers to begin his editorial labors without further announcement. The department of Entomology will be in the able hands of Professor J. H. Comstock, of Cornell University, Ithaca, New York.

In the years 1878 and 1880 Congress, by concurrent resolution, ordered the publication "by the public printer, with the necessary illustrations," of the third and fourth volumes of the final report of the U. S. Geological Survey of the Territories, at that time under the direction of Dr. F. V. Hayden. These volumes were to contain the reports on the Tertiary and Mesozoic Vertebrata of the West, by Professor E. D. Cope, which were to be based on materials preserved in the collection of that naturalist. On the faith of these resolutions of Congress, Professor Cope undertook extensive explorations in all parts of the far West, at his own expense, examining various regions from Southern Texas to Northern Montana, and from Kansas to Oregon and California. This was necessary, since Dr. Hayden's survey was not in a financial position to sustain the expenses of the investigations in the field of vertebrate palæontology, and he had no other collectors of vertebrate fossils than those employed and paid by Professor Cope. The result was the accumulation of a large amount of material, which includes about one thousand species of vertebrata from all the vertebrate-bearing horizons in the Western half of North America, excepting one, and a large amount of material from most of the Eastern bone-bearing beds.

In 1880 the survey under Hayden was abolished on pretence of a consolidation, which was never carried into effect, and a new survey was organized under the direction of Major J. W. Powell. The unfinished work of the Hayden survey was placed in the hands of Major Powell by the following order of the Secretary of the Interior, Teller:

"WASHINGTON, Sept. 27, 1882.

"MAJ. J. W. POWELL,

"*Director U. S. Geological Survey, City:*

"SIR,—The letter of Dr. H. V. Hayden, dated June 27th, bearing your endorsement of July 20th, relating to the unpublished reports of the survey formerly under his charge, is herewith returned.

"You will please take charge of the publications referred to in the same in accordance with the suggestions made by Professor Hayden.

"It is the desire of this office that these volumes shall be completed and published as early as practicable.

"Very respectfully,

"H. M. TELLER, *Secretary.*"

In spite of the above order, no part of Volumes III. and IV. of the Hayden series which was not previously in the printer's hands, has been sent to the Government printing-office, nor even been prepared for it since they came under the control of Major Powell. The verbal promise made to Dr. Hayden and Professor Cope by Major Powell, that part of the unfinished work represented by these volumes would be undertaken and completed as part of the work of the new survey, was not fulfilled; and inquiry finally elicited the statement from the director that this unfinished work would not be published by him.

Under these circumstances, Professor Cope, with the advice and consent of Dr. Hayden, applied to Congress for a small appropriation to pay the expenses of the preparation of the reports. The amount required per annum was three thousand eight hundred dollars, of which one thousand dollars was for an artist, seven hundred and twenty dollars for a preparateur of materials, and two thousand and eighty dollars for the preparation of the text and completing the reports. A lump amount was at first asked for in the winter of 1885–86, but failed for want of the approval of the Secretary of the Interior. The smaller amount asked for at the session of Congress of 1886–87 was approved by the Interior Department and by the Senate, but was lost in the conference between the committees of the Senate and House, during the last days of the term.

This explanation is due to the various palæontologists and others who are interested in the completion of the work so successfully begun sixteen years ago, and for which so many preliminary publications have been made. The long delay in publishing the illustrations, of which many have been prepared, is thus accounted for, although the inconvenience experienced by students is not diminished thereby.

Pending the consideration of the question by Congress, letters approving or urging its favorable consideration by that body were received from Professors Baird, Osborn, and Scott in this country, and Flower, Gaudry, Rütimeyer, and Zittel in Europe. Notes favoring such action by Congress appeared in the *Jahrbuch für Mineralogie* and *Cosmos* in Germany.

RECENT LITERATURE.

Ridgeway's Nomenclature of Colors.[1]—This work has a value to others than naturalists, for it gives first a large number of hints upon the selection of water-colors, pointing out thirty-six of the most useful and most permanent forms, and then how these can be combined to make one hundred distinct shades. Next is a comparative vocabulary of the names of colors in English, Latin, German, French, Spanish, Italian, Norwegian, and Danish. Illustrating this part of the work are ten colored plates, which contain one hundred and ninety-two distinct shades, each one named, while the explanation of each plate tells how these can be produced from the thirty-six colors deemed most essential for the water-color artist. As will readily be seen, this illustrated nomenclator renders the work of great value to the artist as well as to the naturalist, who has frequently considerable difficulty in his descriptions, of deciding exactly the meaning of nearly synonymous terms. Could this nomenclature have a further

[1] Ridgeway, Robert: A Nomenclature of Colors for Naturalists, and Compendium of Useful Knowledge for Ornithologists. 8vo. pp. 129, pls. 17. Boston: Little, Brown & Co., 1886.

introduction, and its terminology replace the meaningless terms like "elephant's breath," etc., introduced in trade, it would have a very beneficial effect. As to the correctness of the colors we cannot in all cases decide. We have never seen clothes worn as long as the famous ones of the Spanish queen, but should judge that the representation of "Isabella color" was about the hue that linen would assume under such conditions.

The only bibliographical omission we observe is the absence of reference to the two handsome volumes of Hay.

The remainder of the book is more especially suited for the ornithologist. It contains a vocabulary of the technical terms used in descriptive ornithology, which occupies fifty-eight pages; tables for the conversion of metric into English measures, and others for reducing inches to millimetres. The seven plates which illustrate this part of the book give the parts of a bird named. The portions of the head, shapes of wings, different markings of feathers, shapes of eggs, and comparisons of millimetres with English and French inches. The most noticeable omissions in these plates are those of the shapes of bills and feet. The work is well printed and bound, and will doubtless find a sale among others than the ornithologists, for whom it is specially intended.

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Pelseneer, Paul.—Notice sur un Crustacé de la craie brune des environs de Mons. —Notice sur un Crustacé des sables verts de Grandpré.—Note sur la présence de *Caradina desmaresti* dans les eaux de la Meuse.—Notice sur les Mollusques recueillis par M. le Capitaine Storms dans la région du Tanganyka.—Notice sur les Crustacés Décapodes du Maestrichtien du Limbourg. Ext. Bulletin. Mus. Roy. d'Hist. Nat. Belgique, iv., 1885–1886. From the author.

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GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

Notes upon Warping of the Earth's Crust in its Relation to the Origin of the Basins of the Great Lakes.—Evidence of unequal oscillation of continental areas, producing warping of the crust of the earth in the valley of the Mississippi and in the basins of the Great Lakes, is of importance. Numerous borings have been made by the Mississippi River Commission—along the course of the Mississippi River, and on its flood-plains between Lake Providence, La., and New Madrid, Mo.—that have passed through the alluvium and entered the Lignitic clays, which Mr. Wilson (of the Commission) identified as those of the Lignitic (Eocene) group of Professor Hilgard.

From measurements of these borings, given in the Report of the Commission for 1881, I have found that the slope of the bed of the preglacial valley, for a distance of three hundred miles below New Madrid, is only 0.41 foot per mile, while that of the modern surface throughout the same region is 0.62 foot. Between Lake Providence and the Gulf the slope of the surface is only

0.35 foot per mile, while that of the ancient bed is indefinitely greater, as shown from the record of the borings of the deep well at New Orleans. From New Madrid to St. Louis the slope of the valley is 0.73 foot per mile, but above it is reduced to about half a foot, throughout a long stretch below Rock Island Rapids. Above the Rapids (where the fall is twenty-two feet in fourteen miles), for two hundred miles the slope, so much nearer its higher waters, is again reduced to only 0.28 foot per mile.

The valley at St. Louis is about eight miles wide. Within a mile of its western side, as shown at the eastern abutment of the St. Louis bridge, the old channel reaches to a depth below the flood-plain of one hundred and thirty-six feet, increasing towards the eastward. Therefore there is every reason to conclude that from New Madrid to St. Louis, or even above it, the floor of the buried valley slopes less than that of modern days, although the borings upon its margin are not so deep as those at New Madrid, which are several miles away from the edges of the flood-plains.

Above St. Louis, the valley, with a breadth of several miles, narrows more or less gradually, except at two places, as we ascend it for eight hundred miles. At these two places the contraction is sudden, and only adjacent to them does the river flow over hard rock. The lower of these two exceptions is along the Des Moines Rapids, at Keokuk, adjacent to which General G. K. Warren discovered a buried channel through which the river once flowed. The other locality where the valley is narrow is below Rock Island. Above here the valley of the Mississippi broadens out and joins the valley of Rock River of Illinois. Along the Rapids, which are on the western side of Rock Island, the river passes over a limestone-bed, which dips at a low angle down its course. From this point to the mouth of the Mississippi the size of the valley is more or less in conformity with the erosive power of a constantly-increasing body of water. But from Rock Island down to Muscatine the river flows through a comparatively narrow cañon, which is quite out of keeping with the size of the valley above and below this section, showing an origin under different physical conditions. At Muscatine it suddenly widens out to eight miles. General G. K. Warren and other gentlemen, besides the writer, have endeavored to find an adjacent buried channel of commensurate importance with the size of that above and below this region, but without success.

Northward of St. Louis the floor of the buried valley rises. It is not known whether the modern channel of the Des Moines Rapids at Keokuk has been produced by erosion into the rocky floor, exposed by the upward warping of the earth's crust, or by the river deflected over hard rock by the filling up of Warren's channel to the westward.

As has been stated, the slope of the valley above Rock Island Rapids is only half that below. But a more striking difference exists along this floor of the buried channel, as shown by various borings at Prairie du Chien, La Crosse, and elsewhere, from which we learn that the bottom does not slope southward, but actually to the northward. Even at La Crosse, two hundred miles north of Rock Island Rapids, the bed of the old channel is fifty feet below that at the Rapids.

From the above observations it is apparent that there is a transverse warping across the Mississippi, which has culminated at Rock Island, and exposed a floor of the hard rocks to be eroded during later geological days. The uplift is further demonstrated by the observations of Mr. W. J. McGee, who finds that an old channel of the Mississippi leaves the mouth of the Maquoketa River, and is coincident with it for several miles, and then passes southward to the valley of the Wapsipenicon, with which it is identical to its mouth. This old valley is from one to three miles wide, and rises to fifty feet above the Mississippi River. It is cut not only through the Palæozoic rocks, but also through the Drift and Loess. The floor consists of alluvium only. Accordingly, the uplift or warping has been quite recent. As this channel is above Rock Island, its presence does not relieve the necessity for an explanation of the stricture in the valley below that place, but only shows more plainly the warping of the strata in later geological times, which has brought up the old rocky floor of the region to be chiselled into by the waters flowing since the Drift epoch.

This warping is part of a fold which extends across the continent to the Great Lakes, and has a bearing upon the production and separation of their basins. A low anticlinal extends from the head of Lake Ontario westward, between Lake Huron and Lake Erie, and beyond, as was long ago pointed out by the geological survey of Canada. It is along the axis of this fold that the Dundas valley—part of the ancient outlet of the Erie basin—is located, where the dip of the strata upon the southern side is twenty-five to thirty-seven feet per mile to west of south, and eighty feet and upward upon the northern side in the opposite direction. In the peninsula (thus rendered somewhat weak) between the Lakes Ontario and Erie local warpings are visible in many places. Furthermore, Mr. G. K. Gilbert has observed that the old shore-lines about Lake Erie rise to the eastward and northward, thus showing that the basins across the old outlet have been recently raised.

The same gentleman has also observed that a conspicuous terrace south of Lake Ontario rises one hundred and thirty feet in proceeding from the western end of the lake to Oneida Lake, south of its eastern end. From this region northward to Adams Creek, Jefferson County, the terrace rises one hundred and seventy feet more; but north of this it has not been seen (*Science*, September 11, 1885). Further evidence of warping along a line probably reaching northward as far as the eastern end of the lake has been gathered by Mr. W. J. McGee, who finds a recent uplift of twenty-five feet in Virginia to four hundred to five hundred at New York, which has not been followed farther northward.

The Palæozoic strata at the eastern end of Lake Ontario has a much greater dip than at the western end; for near the outlet the Trenton limestones dip from fifty-three feet in a mile to three or four degrees, and in direction eastward of south. A depression of only ten or twelve feet from the outlet of the lake southward, during a period of high continental elevation, when the valley of Lake Ontario was formed (and we know from the soundings in the St. Lawrence, farther down, that the elevation reached to twelve hundred feet at least), would be sufficient to make the broad plain adjacent to the St. Lawrence a continuation of the valley of Ontario, and drain all of its waters.

The time of general warping doubtless took place during the periods of oscillation between that of high continental elevation before the Ice Age, and the subsequent submergence in the later Pleistocene epoch to perhaps seventeen hundred feet, in Ontario and Michigan, below the present level (some of the present terraces north of Lake Ontario are certainly marine), and that of the adjustment to the present relative elevation of land and sea, which, to a considerable extent, has been since the Terrace epoch.—*J. W. Spencer, Ph.D., F.G.S., University of Missouri*, January, 1887.

The Formations of the Belly River of Canada.—In his report on the geological survey of the Dominion, Mr. George M. Dawson describes a new formation, to which he gives the name of the Belly River epoch.

The deposit is immediately overlaid by the Pierre or number four cretaceous of Meek and Hayden, which in turn is overlaid by the Laramie. The Belly River beds are of lacustrine origin. It is well known that the Pierre beds are of marine origin, while the Laramie beds are lacustrine. The Pierre fauna of the Dominion is identical with that already known, while the Belly River beds also contain numerous fossil remains. The plants have been studied by Sir William Dawson, who finds them to be identical with those of the Laramie. The same conclusions have been reached by Mr. Whiteaves as to the Mollusca, and Professor Cope finds the vertebrates, of which there are numerous species, to be identical with those of the Laramie. It is difficult to believe that the same land fauna continued during two geological epochs so generally different as those of the Pierre and those of the Laramie. It is also difficult to believe that a deep-sea marine fauna could have occupied the interior of the continent during the stage of elevation presented by the Laramie. It is therefore suspected that there has been some error of observation. It must be said, however, that the conclusions of Mr. Dawson have been confirmed by two other competent members of the survey.—*E. D. Cope.*

The Cross-Timbers of Texas.—The paper recently read before the Washington Philosophical Society on "The Cross-Timbers of Texas," by Mr. Robert T. Hill, who is a native of that State, and now connected with the United States Geological Survey, gives some interesting data about that hitherto little studied region. The article demonstrated that these two belts of anomalous timber, instead of representing quaternary or tertiary basins, are merely the detritus of outcrops of arenaceous strata, those of the eastern member being probably of the age of Dakota sandstone, and the western of a sandy group at the base of the entire cretaceous series, part of which are of undetermined Mesozoic, and are given the name of "Dinosaur Sands" by Mr. Hill, while part of them are of undoubted Carboniferous age. He furthermore shows that the topography of the entire central region is the result of extensive denudation, whereby the members of the geologic series, from the marine tertiary to the Carboniferous coal-measures, are successively exposed along the line of the Texas Pacific Railroad, from Elmo to Millsap. The most interesting feature of Mr. Hill's paper, however, is that he demonstrates the existence of a marine group of the Cretaceous in Texas lower than any heretofore recognized in America, and completely clears up, by methods of stratagraphic palæontology, the vagueness that has hitherto accompanied our knowledge of that region. The palæontological results of the work are also very interesting, and will be studied and presented by Dr. C. A. White.

MINERALOGY AND PETROGRAPHY.[1]

Rosenbusch's "Massige Gesteine."—It is rarely that the revision of a standard work in any branch of science is followed with so much interest as has been the case with Professor Rosenbusch's "Mikroskopische Physiographie der Mineralien und Gesteine," the first part of the second volume[2] of which has recently been issued. When the first edition of this classical work appeared (1877) the study of rocks by means of the microscope had but just begun to take its place as an independent science, requiring new methods of investigation, new apparatus for these investigations, and new modes of reasoning by which the truths revealed by them could be made use of in the elucidation of many obscure problems in the broader science of geology. It is not surprising, then, that as petrography increased its store of

[1] Edited by Dr. W. S. Bayley, Madison, Wisconsin.

[2] Massige Gesteine, I. Abt., Stuttgart, 1886. E. Schweizer bart'sche Verlagshandlung (E. Koch).

observed facts, and the number of minds devoting themselves to the application of these facts to the study of the rocks themselves and to their origin became greater, new fields were explored and new facts were observed, which seemed to contradict many of the deductions obtained by the earlier investigators, and rendered a revision of their views necessary. This is especially true in regard to the classification of the massive rocks, the separation of these rock-masses into families,—into groups, all the members of which are characterized by certain general properties which mark them as belonging to the same group, and distinguish them from the members of other groups. Until we know the history of every rock on our globe and can trace it back to its origin through all the changes which it has undergone since its first existence as a distinct portion of the original molten magma, all attempts at a perfect classification of these bodies must be futile, and the classification itself must be an artificial one. As we can never expect to know everything relating to even a single rock type, so we can never expect to possess a perfect classification of rocks. The differences in structure produced during the solidification of molten masses by slight differences in the conditions of temperature and pressure under which they cool are so great, and our knowledge of the effects of these differences is so limited, that we must be content with that classification which best conforms with the facts known and incorporates them in a consistent whole. In no *natural* science can we hope for more than this, and least of all can we hope for it in petrography, the materials of which are the embodiments of the action of largely unknown conditions on substances of whose original nature little can be *positively* known. It is safe to affirm that no classification of rocks ever proposed has met with such general acceptation as that of Professor Rosenbusch's as developed in the first edition of his "Massige Gesteine." That this, however, did not fully meet the requirements of the rapidly-growing science has been acknowledged for some years past. That classification was based upon the fundamental notion that rocks erupted before the Tertiary period in geological time, in consequence of certain conditions then prevailing, possessed structural and mineralogical characteristics which distinguished them from those of more recent age. This, then, was taken as the ground upon which to separate all massive rocks into two great divisions,—the pre-Tertiary and the recent rocks. These were again subdivided according to their structure into granular, porphyritic, and glassy rocks; and finally the members of the subdivisions were classified by groups in accordance with their mineralogical composition. Recent investigations, especially those of Italian and American workers, have shown that structure is dependent not upon the age at which rock-masses were formed, but rather upon the geological conditions under which they were produced. A mass of molten material which flowed out upon a land surface and there cooled, no matter in what geological period, always possesses characteristics which distinguish it from a mass of the same chemical composition which cooled slowly at some distance below the surface. It is probable that rocks of the latter class have been formed throughout all time since the beginning of the Laurentian, and may be in process of formation at present, but at such depths that we can never hope to see them. That most of the plutonic rocks with which we have to deal were really formed early in the earth's history, is due merely to the fact that that portion of the earth's crust in which they are found has been eroded to such an extent as to lay bare its innermost depths.

In the new volume under consideration, Rosenbusch characterizes these deeply-formed rocks as possessing, I., each of their constituents in but one generation, and, II., so developed that the different individuals have mutually interfered with each other's growth, thus giving rise to the granular (kőrnige) structure. When none of the constituents possess crystal outlines, the structure is called *hypidiomorphic;* when certain of the constituents are so developed, the structure is known as *panidiomorphic.* Rocks which were produced at great depths, and consequently possess this granular structure, are designated as intrusive or plutonic (Tiefengesteine).

The intrusive rocks are subdivided in accordance with their chemical and mineralogical composition into granites, syenites, eleolite syenites, diorites, gabbros and norites, diabases, theralites, and peridotites. All these are characterized by the possession of the *hypidiomorphic* structure, in which by far the larger part of the constituents are *allotriomorphic* (possess a form due to external causes and not to the action of intermolecular forces,—*i.e.*, are not developed with crystal outlines). When any of the intrusive rocks occur as sheets between older rocks (are "Lagerfőrmig") they assume some of the peculiarities of rocks which cooled at or near the surface. In other words, some of their constituents become *idiomorphic* (possess crystal outlines), and the rock tends to the *panidiomorphic* structure, such as many of the diabases.

On glancing over the list of the names of intrusive rocks, it will be noticed that in it are included, with the single exception of teschnite, all those formerly described as pre-Tertiary with a granular structure. In the place of teschnite we find the new type theralite.

The abolition of the old type teschnite is due particularly to the work of Rohrbach, who, in 1885, after a thorough examination of specimens from every locality within his reach, concluded that in not a single instance could any trace of nepheline be detected. He referred most of the teschnites to the diabase group. This disposition Rosenbusch accepts as the correct one for many of the rocks heretofore denominated teschnites, and among them that from Teschen, Moravia, named by Hohenegger teschnite, in which Zirkel, in 1868, and Tschermak, in 1869, thought they had found nepheline. Since, therefore, the original teschnite is probably only a variety of diabase, it was thought best to drop the name as descriptive of intrusive nepheline-plagioclase rocks, and to substitute for it the name theralite (θηρᾷν—seek diligently).

This name is intended to cover all intrusive rocks containing nepheline and plagioclase as prime constituents. That such rocks occur has not yet been positively proved, although the recent work of Wolff in Montana and the earlier work of Hawes and of Harrington in the neighborhood of Montreal, Canada, render their existence probable.

The gabbros and the norites have been included together in one family, the former comprehending those plagioclase rocks in which a monoclinic augite (of a composition approaching that of diallage) occurs as the predominant bisilicate constituent, and the latter those in which this augitic constituent is orthorhombic. Every gradation between the typical gabbro and the typical norite is recognized as possible.

The diabases are regarded as occupying a peculiar position among the intrusive rocks. Their occurrence as sheets between clastic rocks allows them sometimes to assume certain of the characteristics of thin magmas which cooled at the surface, such as the possession of amygdaloidal upper surfaces, the association with them of tufas, etc. The greater mass of diabase, however, Rosenbusch describes as intrusive (in sheets or dykes), hypidiomorphic granular rocks, generally of an early geological age, though occasionally of a very recent one, which possess as essential constituents a plagioclase and augite. In his earlier description of this rock chlorite also was considered as essential. This mineral is now regarded as merely secondary, the last product in the alteration of the augite. In this connection occasion is taken to remark that uralitizatine is not a paramorphism of hornblende after augite, but that the change is probably due to loss of calcium,—the hornblende is an apomorph. The frequent association of epidote with chlorite would seem to confirm this view.

The new name Harzburgite is proposed for the hypersthene and bronzite peridotites, which Wadsworth in his "Lithological Studies" calls Saxonite.[1] Wadsworth's name is based on a description of Dathe's, which this writer himself acknowledges to be erroneous in some of its essential particulars.

The second great class is that of the dyke rocks. These are not as well characterized as the intrusive class. The conditions

[1] American Naturalist, Notes, May, 1885, p. 499.

under which they solidified have varied to such an extent, in consequence of differences in the thickness of the dyke, in the depths at which given portions crystallized, in the degree of conductivity of the rocks penetrated, etc., that all types of structure are found among them. As might be expected, this class is much less well defined than that of the intrusive rocks considered above, or that of the effusive rocks to be examined later. In it are included only those rocks which can neither be regarded as intrusive nor yet as effusive. They are divided according to structure into three distinct types,—I., the granitic; II., the grano-porphyritic; and, III., the lamprophyric. They all tend to the development of one or the other of their constituents in porphyritic crystals; in other words, they are all panidiomorphic.

The granitic class includes only aplite and beresite.

The structure of the grano-porphyritic type is defined by the name. They are porphyries in the sense that they contain certain of their ingredients in two generations, but differ from them in the possession of a holocrystalline ground-mass. Among the grano-porphyritic class are placed granite-porphyry, syenite-porphyry, eleolite-syenite-porphyry, diorite-porphyrite, and quartz-diorite-porphyrite. It will be seen that this class embraces most of those pre-Tertiary porphyritic rocks that are not true porphyries.

The lamprophyres are distinguished from the grano-porphyritic group by the prevalence of bisilicates and the subordination of the feldspathic constituents. They consist of a fine-grained to very compact (dicht) ground-mass, in which porphyritic crystals of biotite, augite, or hornblende are scattered. They all weather very readily, and, as a consequence, contain a great deal of calcite, so that in many cases before their structure can be studied it is necessary to etch their thin sections with a dilute acid.

The lamprophyres are subdivided into the syenitic and the dioritic varieties. The syenitic varieties include minette, characterized by the predominance of biotite, and vogesite, in which the place of the biotite is taken by hornblende or augite. The dioritic varieties embrace kersantite and camptonite. The latter name is applied to the porphyritic diorites described by Hawes[1] from the neighborhood of Campton, N. H. They contain porphyritic brown hornblende and lath-shaped plagioclase crystals in a ground-mass composed essentially of green augite, apatite, and a glassy base in which amygdules occasionally exist.

The third and last great class of rocks is that of the effusives (Ergussgesteine). It embraces those which were poured out upon the surface and then solidified. They are found in sheets and in volcanic streams (Decke and Ströme). There seems to be no reason why there should not be a corresponding effusive rock

[1] Mineralogy and Lithology of New Hampshire, 1878, p. 160.

for every intrusive one, if difference of structure is due merely to difference in conditions of cooling. As a fact, however, it is found that the effusive rocks are always more acid than their corresponding intrusive equivalents. This is accounted for by Rosenbusch on the assumption that during the gradual rise of the magma in the cracks through which it reached the surface enough time was consumed to allow of its separation into strata, the heavier, more basic portions accumulating towards the bottom, and the lighter portion floating on the top.

The characteristic structure of the effusive rocks is the porphyritic. The porphyritic crystals are supposed to have been developed at the period during which the rock was ascending to the surface. After it reached the surface another more rapid crystallization set in, and the result is a glassy or finely-granular ground-mass.

The effusive rocks are divided into two classes, according to age. This is the only remnant left of the old classification into pre-Tertiary and recent rocks. Here certain characteristics are noted in those rocks erupted at an early geological period, which distinguish them from the rocks of later eruptions,—*e.g.*, the ground-mass, of the older rocks, is more lithoidal in character than that of the younger ones, the appearance of their porphyritic feldspathic constituents is different, etc. Whether these differences are of primary or secondary origin is still a matter of doubt. The pretertiary effusive rocks are known as palæo-volcanic, the younger ones as neo-volcanic.

The palæo-volcanic rocks include the quartz-porphyries, quartz-free-porphyries, porphyrites, augite-porphyrites and melaphyres, and the pikrite-porphyrites.

The full discussion of the different varieties of the palæo-volcanic rocks and the entire discussion of the younger class are left to the second part of the book, which is promised to appear in a few months. It is of course impossible to give any adequate conception of the amount of new material incorporated in this volume, or even to mention all the important results reached in its consideration. Perhaps the most important of all the advances have been in the direction of what is now known as dynamical metamorphism, by the action of which a massive rock is made to assume a schistose structure. This mode of alteration is treated in some detail.

It is needless to say that the very latest publications have all been critically examined and their teachings made use of in developing the new system of classification. It is a matter worthy of note that quite a large proportion of the most instructive papers bearing on this subject have been presented by Americans.

Instructors in petrography, and all those to whom a ready knowledge of German is denied, will be glad to learn that a translation of both the first and second volumes of the "Mikroskopische Physiographie" is contemplated by Mr. J. P. Iddings, of Washington. It is proposed to omit those parts which are not essential to the production of a good text-book, and to incorporate the remaining portions in one volume. As the labor involved in translating the work is very great, it may be some time before the English version is given to the public.

BOTANY.[1]

A Study of the Growing Parts of the Stem of Pinus strobus. THE WHITE PINE.[2]—Before beginning work on this special part of the subject a cursory examination was made of the tissues in general as compared with that of *Pinus sylvestris*, the so-called Scotch Pine. Roughly speaking, they are the same,—a central pith, a zone of xylem varying in width according to the number of years' growth, the phlœum, outer cortex, and the epidermal system. But by direct comparison the tissue of the White Pine is seen to be more dense than that of its foreign relative,—the cells having a smaller diameter and the resin passages being smaller and less numerous.

In *Pinus sylvestris* there are two rows of resin passages in each year's growth of the xylem, one comparatively near each margin of the zone, while in *Pinus strobus* there is but one row, which lies towards the outer part of the zone. Sometimes an extra passage is found lying deeper in the xylem. On the contrary, in the outer cortical tissue of *Pinus strobus* are two rows of resin passages, the inner row being much larger than the outer one, but both being quite large, while there is but one row found here in *Pinus sylvestris*.

Growing from the epidermis of the bud and young shoot of *Pinus strobus* are many glandular, often capitate, hairs, composed of but two or three somewhat elongated cells, filled with densely granular matter. These appear to be secretory hairs, producing the resin that is found in such abundance in the bud of the White Pine. They were not found in the Scotch Pine.

In the phlœum, in elongated cells which are distributed irregularly throughout this tissue, with the exception that they never occur within a zone of about eight cells from the xylem, occur large numbers of crystals of oxalate of lime. Fig. 1 of plate is a camera drawing of a longitudinal tangential section through the phlœum of a one-year-old stem, showing parts of five of these cells, three of which contain crystals. These crystals do not lie in the cell-wall, but are embedded in a substance which more or less completely fills the cell, offers great resistance to acids, is

[1] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

[2] Selected for publication from original work of students in the botanical laboratory of the University of Michigan, 1885–86, and communicated by Professor V. M. Spalding.

PLATE IX.

not affected by ether, and stains from yellowish brown to dark blue with Hanstein's aniline violet. The cells surrounding these contain much starch and protoplasm, with usually a nucleus.

Resin passages are also found in the phlœum and outer cortex, which do not run parallel to the long axis of the stem. Some were found running radially from towards the centre. At one end of some of these radially directed passages they bend at, or nearly at, a right angle, and pass up the stem. The great majority, however, run longitudinally through the stem.

Looking at the stem as a whole, at the centre is the pith or central cortex, composed of loose parenchymatous cells, then the protoxylem, composed of groups of scalariform and spiral vessels, which merge into the zone of xylem, composed of elongated ligneous cells, whose radial walls are thickly pitted. Outside of this is the cambium, or "growing part," a zone of cells with cellulose walls, definitely marked off from the xylem, but merging without any distinction into the zone of phlœum. In the stem cut in the winter, when growth is arrested, there is a zone varying from about three to five cells broad, in which the cell-walls stain somewhat more quickly and deeply with Schultze's solution than those of the surrounding tissue, and the cells of this zone are more densely filled with granular protoplasm. Fig. 2 is a camera drawing of a cross-section of a stem in which growth had not yet commenced: (*x*) a few cells of xylem, (*c*) the cambium zone and (*p*) the phlœum, (*m*) a medullary ray reaching only into the edge of the xylem.

Beyond the cambium is the zone of phlœum, composed largely of sieve-tubes, but containing the elements before described. Next is the outer cortical zone, with elements very similar to those of the pith, and outside this the epidermal system.

This much with the view of obtaining a better understanding of the position and of the elements in which growth takes place.

My method in the work was as follows: Stems from one to four years old, and buds, or young shoots, as the case might be, were taken from a thrifty growing tree at periods varying from four to ten days apart, and beginning before the commencement of growth in the spring. This material was preserved in alcohol and used as desired. Schultze's solution and Hanstein's aniline violet gave the best satisfaction as staining agents: Schultze's solution for differentiation of tissues, the aniline violet for staining nuclei. To clarify the sections, after cutting I placed them in sulphuric ether for some time, which removed the resinous substances, then, if staining with the violet, I removed them to a reduced solution of this, and after overstaining removed the excess with alcohol by placing the sections in it for a short time, and afterwards cleared with clove oil and mounted in dammar.

Taking the bud first, as it seems the most suitable place to start with, I found the growth for a period of a few weeks proceeding much more rapidly in the cortical and medullary tissue than in any other place. The first signs of growth appeared about April 20; and in the material cut May 6, the cells of these tissues were in their most active state of division, longitudinal sections showing large numbers of dividing nuclei. At this time the ground tissue composed the greater part of the stem, though the vascular system had increased considerably. Soon the growth in the cortical and medullary tissues almost entirely ceased. May 27, cell-division had so nearly ceased in these tissues that I could find no dividing nuclei, though I spent much time looking for them; and in the same material cell-division was taking place along the cambium line.

But growth does not entirely cease, at least in the outer cortex, for I found cell-division here in a three years' growth.

Fig. 3, *a*, is a camera drawing from near the epidermis of a three-year-old stem, showing a nucleus that has divided and the new cell-wall just formed. I think, in this tissue, growth continues by cell-division as long as the tree lives. Growth also takes place here by these cells becoming somewhat larger, and they often become elongated somewhat tangentially.

As to the length of life of these cells I can say but little. Many were found, even in the first year's growth, which were empty and dead; but in the same tissue taken from the body of a tree eight inches in diameter the great majority of the cells contained protoplasm and nuclei. I do not think the central cortical tissue lives very long, though I found some cells of a four years' growth containing protoplasm and starch.

The main growth of the stem is along the line of cells designated as the "cambium zone." On one side the cells that are here newly formed pass into the xylem, on the other into the phlœum. As each year's growth of xylem is much larger than that of the phlœum, many more cells must go to the formation of xylem than of phlœum.

To all appearances, when the stem is growing, the cambium zone is but one cell broad, as all nuclei that show signs of division in this tissue are found along a straight line in a longitudinal radial section.

Fig. 3, *c*, is a longitudinal section through a three-year-old stem, cut May 26, showing cell-division through the shorter diameter of a cambium-cell, thus showing that there must be some growth in length after the stem is three years old.

I found neither protoplasm nor nuclei in the xylem more than one year old, but in cells of the medullary rays passing through the zylem, and which were four years old, I found protoplasm and nuclei.

Many cells of the phlœum, in all specimens examined, were apparently empty and lifeless, but the great majority contained nuclei. Some of these cells must have been quite old, as I examined some sections of phlœum from the body of a tree about eight inches in diameter.

In studying the structure of the nucleus and the process of cell-division, I had about equal success in the three above-mentioned tissues.

Fig. 4 is from a drawing of a cross-section of a young shoot cut April 26, showing a few cells of the xylem (*x*), the newly-formed tissue (*n*), some cells of the old phlœum (*p*), and a medullary ray (*m*). In this shoot a zone about seven cells broad had formed.

To obtain some idea of the rate of cell-division I made an estimate of the number of newly-formed cells produced by the cambium in a piece of a three-year-old stem one inch long, cut April 26, by counting the number of cells in the breadth of the zone, the number of cells around the stem, measuring the length of a number of cells, and taking the average. Also, in obtaining the number of cells around the stem, I took four sections from different stems, but all of about average size, and took the average. By this means I estimated the number of newly-formed cells, in such a piece of stem one inch long, April 26, to be 560,640. As April 17 there were no signs of growth, and as I could find but few nuclei and cells in the process of division in the material cut April 26, and from the great number of newly-formed cells, I conclude that the entire process of cell-division can last but a very short time,—perhaps two or three hours.

Fig. 5, *a*, *b*, *c*, *d*, and Fig. 6, *f*, *g*, and *h*, are camera drawings of some of the forms of the dividing nucleus found in the medullary rays along the line of the cambium. These are all from a four years' growth, cut May 6 and 26.

Fig. 6, *i*, and Fig. 3, *b*, *c*, *d*, represent some forms found in the cambium from material the same as the above. Fig. 7 represents cells from the inner cortex of a young shoot cut May 6, and Fig. 8, the same from the outer cortex.

Forms essentially like all these drawn were found in each of the three tissues, and from these we can trace the process of growth of cell-division in the pine.

First the nucleus in a state of repose, the nuclear filament folded so as to appear to be a densely granular ovoid mass. Fig. 3, *b*, shows one of these filaments lying in the cambium of a three years' stem, which was probably straightened by the razor in making the section. It demonstrates the composition of the nucleus. About the first change manifest in division is the segmentation of the nuclear filament, shown in Fig. 5, *c* and *d*. Then these segments double and arrange themselves in a radial manner around a common centre, as shown in somewhat varying stages in Fig. 8, *c*, and Fig. 6, *g* and *h*. Then the formation of the nuclear threads running off from the ends of these segments to the poles of the nuclear spindle, as shown at Fig. 6, *f* and *i*.

These "conjunctive threads," as Fol calls them, arrange themselves in such a manner as to form a double hollow cone with a common base. The segments of the filament then pass out along the line of these threads and gather at the two poles of the spindle. Fig. 5, *a*, and Fig. 8, *b*, show early stages of this transformation, and Fig. 8, *a*, and Fig. 7, *b*, a little later. The new cell-wall or "nuclear plate" is then formed, as shown in Fig. 7, *c*, across these threads at right angles and about midway between the two masses of filaments, the parts of each of which have now united and form a rounded mass, in appearance like the mother-nucleus. The formation of the nuclear plate continues until it reaches across the cell from side to side and forms a complete cell-wall. All these sections are radial longitudinal ones.—*Elmer Sanford.*

ENTOMOLOGY.

Critical Remarks on the Literature of the Organ of Smell in Arthropods.—[The following abstract of the more important portions of Kraepelin's criticisms on the works of writers on the olfactory organs of arthropods, may prove not unwelcome to our entomologists, who may never be able to obtain Kraepelin's rather rare pamphlet. See pp. 889 and 973 of vol. xx.—*A. S. Packard.*]

My own observations on different groups of insects agree, in general, with those of Perris, Forel, and Hauser, without being in a position to confirm or deny the varying relations of the Hemiptera. That irritating odorous substances (chloroform, acetic acid) cause the limbs to move in sympathy with the stimulus, I have seen several times in Acanthosoma; still it may be a gustatory rather than olfactory stimulus.

As regards Crustacea, there are no observations or experiments (except on Asellus) on the conjectural seat of their olfactory organs. It should be here mentioned that Jourdain has described and Professor Dohrn, in Naples, has reported to me that the Brachyura by a remarkable movement of their inner antennæ, which are almost continually in convulsive movements, seem to support the opinion long entertained of the perception of odors by the antennæ.

As to spiders, it is not certainly known whether and to what extent they share in the sense of smell. Robineau-Desvoidy (1842) said that their sense of smell is very well developed and localized in the mandibles, but Perris placed them in the lowest rank of arthropods, though he remarks on "the sensibility of their palpi to smells."

Turning now from speculation and simple observation to exact anatomical and histological data, the nerve-end apparatus seems to have a distinct reference to the perception of odors. It comprises a structure composed of nervous substances which are enclosed in a chitinous tube, and either only stand in relation to the surrounding bodies by the perforated point, or pass to the surface as free nerve-fibrillæ.

Wolff's theory that the sense of smell is lodged in the skin of the soft palate-like roof of the mouth is published in a work of two hundred and fifty quarto pages, which shows so much skill, acuteness, and subtle reasoning that his views prevailed for several years, and were adopted by Graber in his well-known work on insects. Forel appears to have been the first to oppose Wolff's conclusions, both on theoretical grounds and from his experiments on Polistes and Sphex. Leydig, in his work on Amphipoda and Isopoda (p. 235), expresses the view that "this nasal skin possesses nothing more special than other regions of the skin which should be considered as tactile." I think that Leydig is here perfectly correct, and that those small pit-hairs are plainly tactile organs, since such must be present in the mouth near the organs of taste. Moreover, it is generally doubtful whether such direct sense-perceptions as smell and taste can pass through chitinous membranes; a perforation of their terminations has never been observed in the hairs under consideration. Hence the analogously formed hairs in the suctorial canal of the dipterous labrum [hypopharynx] in their whole arrangement (they stand in two longitudinal rows like the trees on each side of an alley) show that they are formed to feel and repel solid bodies, rather than to smell them. The presence of a gland differing in the nature of its secretion from the other glands of the mouth, on which Wolff laid so great weight, should not have much force as an argument, since we know as good as nothing of the chemistry of digestion and the secretions in insects necessary for it. The apparatus is better fitted by its situation for a gustatory apparatus. Hence we should adopt Leydig's view of the tactile nature of these minute hairs so long as no further anatomical and physiological data prove their gustatory function.

In insects there is a remarkable and fundamental difference in the structures of the parts supposed to be the organs of smell. Erichson (10) was acquainted only with the "pori" covered by a thin membrane; but Burmeister (11), in his careful work on the antennæ of the lamellicorns, distinguished pits at the bottom of which hairs rise from a glass-like tubercle, from those which were free from hairs. Leydig (14) afterwards was the first to regard as olfactory organs the so-called pegs (kegel), a short, thick hair-like structure distinctly perforated at the tip, which had already by Lespès (38) in Cercopsis, etc., been described as a kind of tactile papilla. Other very peculiar olfactory organs of different form Forel (Fourmis de la Suisse) discovered in the antennæ of ants, which Lubbock ("On some points," etc.), according to a short notice of Forel, incorrectly associated with the nerve-end apparatus found by Hicks in other insects. This manifold nature of the antennal organs has by the last investigator, Hauser (22), from thorough studies of the nerve-elements belonging to them, been not simplified but rendered more complicated. According to this naturalist we may distinguish the following forms which the olfactory organs may assume: 1. Pale, tooth-like chitinous hairs on the outer surface of the antennæ, which are perforated at the end; nothing is known as to the relation of the nerve passing into it (Chrysopa, Anophthalmus). 2. In pit-like depressions of the antennæ arise *nerve-rods* (without a chitinous case) which stand in direct relation with a ganglion-cell lying under it. These pits are either *simple*, viz., with only an "olfactory rod" (Tabanus and other Diptera, Vanessa), or *compound* (Muscidæ and most other Diptera, and Philonthus). It seems important that these pits are partly *open* (in the above-named groups of insects), and partly *closed* and covered with a thin membrane, under whose concavity the olfactory rods end (Orthoptera, Melolontha, and other lamellicorns). 3. Short, thick pits sunken slightly into the surface of the antennæ, and over this a chitinous peg perforated at the end, in whose base, from the interior, projects a very singular *nerve-peg*, which is situated over an olfactory ganglion-cell, and provided with a slender *crown of little rods*, and flanked on each side by a flagellum-cell (Hymenoptera). 4. Round or crevice-like pits covered over by a perforated chitinous membrane with nerve-rods like those in 3, but in place of the flagellum-cell with "membrane-forming" cells spread before it. Hauser finally mentions further differences in the ganglion-cells sent out into the nerve-end apparatus. These exhibit in Diptera and Melolontha only one nucleus, in Hymenoptera a single very large one (with many nucleoli) and three small ones, in Vanessa six, in Orthoptera a very large number of nuclei, etc. We add beside all these different forms also the Forelian flasks ("microscopical stethoscopes" of Lubbock) not known to Hauser, and the champagne-cork organ in ants; thus we have in fact a very great variety, so that it seems difficult to understand how Hauser could nevertheless ascribe a common function to all these nerve-end apparatuses.

As the final result of my researches I may state *that the great variety of antennal structures previously described may be referred to a single common fundamental type of a more or less developed free or sunken hair-like body which stands in connection by means of a wide pore-canal with a many-nucleated ganglion-cell.*[1] *The latter sends only a relatively slender nerve-fibre* (*axial cord*) *through*

[1] Perhaps this structure might more correctly be considered as a ganglion with numerous cells, since in fact the whole structure of the nerve-mass, namely, in the Hymenoptera, has a great similarity with that of the crustacean antenna.

the pore-canal into the hair; but the same is enclosed by epithelial cells which surround the pore-canal.

Kraepelin thus sums up our present knowledge of the olfactory organs of Coleoptera: *The terminal apparatus of the organ of sense in the antennæ of beetles consists in each case of a chitinous, delicate or thick, long or short hair-like structure, which is planted in the middle of a more or less arched, "dome-like membrane" closing in the wide pore-canal of the antennal wall. This membrane extends over the pore-canal at the same level as the surface of the antennal integument* (Geotrupes, Strangalia), *or it rises as a cupola in the middle of a beaker-shaped pit* (Melolontha, Buprestidæ, Dytiscidæ). *Often such sense-organs (either with or without special pits) are so united that they stand associated in flat depressions of the surface of the antennæ, the so-called "compound" pits* (Melolontha, Strangalia, Euchroma, Lucanus, etc.).—*K. Kraepelin.*

ZOOLOGY.

Mimicry in Amphipods.—Dr. Carl Bovallius describes (*Nova Acta Reg. Soc. Sci. Upsaliensis*, xviii., 1886) a new genus of Hyperid Amphipods, the three species of which are remarkable for their mimicry of jelly-fishes. The head and five, six, or all seven of the thoracic segments are enormously inflated, so that the anterior part of the body closely resembles the bell of a medusa, while the feet and compressed abdomen hang down like the tentacles of the mimicked form. For these forms the generic name Mimonectes is proposed, and even a new family has to be instituted. Among the other more remarkable characters are the following: The eyes "do not form a continuous mass on each side of the head as in the other Hyperids, but consist of six to ten large ocelli scattered over the lower side of the head. These do not show such long crystallic [*sic*] elements as in Phronima, Rhabdosoma, and others, but seem to be composed each of a great many granular, fine, light-breaking corpuscles interspersed with dark brown pigment." The innervation of these ocelli is peculiar; some receive their nerve-supply directly from the brain, while in others the filaments seem to arise from the œsophageal commissures. Whether this is actually the case or not remains to be determined by sections of fresh specimens, but it is interesting to note that all the ocellar nerves (except two) arise *behind* the nerves supplying the antennæ. The "bell" of the animal is filled with a liquid enclosed by a thin pellucid membrane, but as all the material was alcoholic, the nature of the fluid could not be ascertained. The alimentary canal showed no traces of cæca or hepatic glands. The three species are *Mimonectes lovêni*, from the Atlantic; *M. sphæricus*, from near the Canary Isles; and *M. steenstrupii*, from the mouth of Davis Strait.

Australian Cladocera.—It is a well-known fact that the eggs of various fresh-water animals (notably those of Entomostraca) will withstand long desiccation, but still the experiments detailed by Mr. G. O. Sars have considerable interest. A correspondent sent him in Christiania, Norway, some dried mud from the shores of a fresh-water lake in tropical Australia. This mud was placed in water, and from it were hatched out one Copepod, one Ostracode, a species of Polyzoan, apparently belonging to the genus Plumatella, and five species of Cladocera. These last are made the subject of an article of nearly fifty pages and eight plates in the *Forhandlinger Vidensk. Selsk. Christiania* for 1885 (1886). These species all belonged to genera (Daphnia, Diaphanosoma, Ceriodaphnia, Moina, and Leydigia) already known from European waters, and the species themselves closely resembled those of the antipodes, notwithstanding that they came from localities thousands of miles apart and which have entirely different environments. These facts recall to the author the close similarity—even identity—of the crustacean species of Italy and Norway, and he concludes that one cannot lay too great stress on the importance of birds in the distribution of these forms. Sars's paper is, like many others, written in English.

The Myzostomata.—Nansen's beautifully-illustrated "Contributions to the Anatomy and Histology of the Myzostomata" is the last publication of the Bergens Museum. The text (sixty-eight pages) is in Norwegian, but a *résumé* in English of twelve pages places the substance of the article within reach. Two new species are described with great detail, the integument, nervous system, sensory organs, segmental glandular sacs, hook apparatus, alimentary tract, genital organs, complemental males, and hermaphroditism being discussed. Nansen comes into frequent conflict with Beard. Thus he does not believe with Beard that the diœcious forms of Myzostomata were the primitive type, and the hermaphrodite the secondary. He finds nothing resembling the epidermal sense organs or chitinous hollow rods described by Beard, nor can he accept Beard's account of the development of the nervous system by which the larval nervous system disappears and has nothing to do with that of the adult. Nansen considers the "suckers" as "segmental glandulous sacs," stating that they are ciliated, and lack the muscular walls described by Graff. Whether they are homologous with the segmental organs of the Annelids is left undecided. The fact that they do not communicate with the body cavity is the greatest objection to this view, but the ready answer to this is that, unless the cavities in which the ova are situated are such, the cœlom is absent.

Nansen's conclusions as to the systematic position of the

Myzostomata we quote (from the *résumé*) in full: "I cannot agree with Beard in regarding the Myzostomida as belonging to the Chætopods; there are too many dissimilar features in their structure, and I do not think that their development, as described by Beard, is 'quite that of a Chætopod.' The absence of a preoral ring of cilia, the relatively small development of the preoral lobe, and the great development of the body part of the larva are no insignificant differences; they show that the larva is not a little differentiated. The presence of a preanal ring of cilia is common to most Annelid larvæ, and the larvæ of Mollusca, Bryozoa, etc., also usually possess such a ring. In the absence of this ring, as well as in the rudimentary development of the preoral lobe, the larvæ of Myzostomida resemble those of Sipunculus; in their general structure there is, however, but little resemblance to be traced. I am inclined to regard the Myzostomida as a peculiar, distinct group, belonging to the Annelids, related to the Chætopods, but also showing a tendency towards some of the Arachnids (Linguatulida, Tardigrada, and perhaps Pycnogonida) and Crustaceans; they are sprung from the Trochophora; among the Archianelleda their ancestor has been chiefly related to that of Histiodrilus; on the other hand, it has also been related to that of the Arthropods, because the Myzostomida really show, in their structure, a tendency towards these. They are therefore one of those groups presenting the greatest interest as a subject for phylogenetic studies." The present reviewer fails to recognize the arthropodan resemblances of these forms. He is inclined to regard them as Annelids but remotely related to the Chætopods, parasitism having extensively modified them.

Anatomy of Echinorhynchi.—The Acanthocephali have been regarded as devoid of a digestive apparatus, and Lespès's discovery of what he considered the alimentary tract in the pyriform body in the proboscis of *Echinorynchus claviceps*, met with but little acceptance. Recently Megnin has been studying the subject, and gave the result of his researches before the Scientific Congress of Paris. In order to settle the question it was necessary to study these worms at a period before the development of the sexual organs, and when the nutritive system was in full function. Megnin found Echinorhynchi encysted in the cellular tissue of some Varanidæ from the Sahara. These proved to be in a larval stage and to have a digestive apparatus composed of two long convoluted tubes, each giving rise to numerous cæcal diverticula. The whole presents an analogy to the alimentary tract of the Trematodes. In some species, as the *E. brevicollis* found in *Balænoptera sibbaldi*, the digestive apparatus persists and acquires considerable development. In others it undergoes a degeneration and is to be sought in the "lemnisci," structures, heretofore of problematical nature, occasionally regarded as salivary glands. The larvæ have a rudimentary dorsal vessel, and this, with their proboscis and aquiferous apparatus (which, however, is well developed in the adult), shows the relation of the Acanthocephali to the Nemerteans or Rhynchocœla, while the digestive apparatus is more like that of the Trematodes. They can no longer be arranged with the Nematodes.

Argulus and Mortality of Fishes.—In the October number of this journal (vol. xx. p. 856) Mr. F. L. Washburn records an annually recurring extensive mortality of different species of fish in Lake Mille Lac, Minnesota, and describes as the cause of death a Siphonostome, the abdomen of which is furnished with an umbrella-like disk. Although this description hardly answers to an Argulus, yet I think the mode of occurrence and the great mortality point to the parasite being a member of this genus. I do not remember to have seen before an account of such devastations by Argulus in America, but similar accounts from Europe are not uncommon.

Mr. Washburn's note reminded me of the circumstance that two years ago Mr. A. C. Lawson, of the Geological Survey of Canada, brought me an account of a similar mortality of an undetermined species of Coregonus in the Lake of the Woods. He had preserved a number of the parasites, which I marked at the time *Argulus coregoni* Thorell (?), with the intention of determining afterwards whether the Canadian and Norwegian species should turn out to be identical. I find now that the characteristic copulatory ridges on the swimming legs of the male are very different in the Canadian species from those in *Argulus foliaceus* or *coregoni.* Dr. J. S. Kingsley has undertaken to see whether they agree with those in any described American form.

It may be of interest to note here that Leydig, in a recent communication to the *Zoologische Anzeiger* (No. 237), announces that the "poison-sting" of Argulus is in reality a sense organ, the "poison-duct" a broad nerve-tube, and the "poison-gland" a part of the fat body, so that the great mortality caused by Argulids is not to be attributed to any poison injected with the bite.—*R. Ramsay Wright, University College, Toronto,* January 8, 1887.

The Irish Red Deer.—In the March number of the *Zoologist* R. J. Ussher states that the Irish red deer lingered in the mountains of Knockmealdown, Counties Waterford and Tipperary, in 1774, and that its last haunt was Erris, County Mayo, where a few existed as late as 1847, when they were slaughtered for food by the famine-stricken peasantry. The only examples now left are preserved by Lord Kenmare and Mr. Herbert, of Muckross, in County Kerry. Among the occasional notes in the same magazine is one to the effect that a specimen of the American rusty grackle (*Scolecophagus ferrugineus*) was shot last autumn at Cardiff, Wales.

The Birds of India.—W. T. H. in Ward's *Science Bulletin* gives a short notice of the comprehensive ornithological survey of India that has for several years been carried on under the direction and at the expense of Mr. A. O. Hume, Secretary to the Government. Not only India, but British Burmah, Ceylon, the Malay Peninsula, and the Andaman Islands are included in this work. Besides doing a vast amount of field-work himself, and writing largely upon the subject, Mr. Hume has constantly kept from one to three corps of collectors in the field. Among the results of the work is a collection of over forty-five thousand bird-skins and unnumbered eggs at Simla, a superb four-volume work upon the Game Birds of India, and a work on the Nests and Eggs of Indian Birds. Mr. Wm. Davison, one of Mr. Hume's collectors, has found five hundred and eighty species in Tenasserim, and seven hundred and twenty-eight in British Burmah.

The Zoology of British Burmah.—Apropos of the preceding note comes a condensed account of the contents of the "Gazetteer of British Burmah," for which we are indebted to the *Revue Scientifique* of April 1. The mammiferous fauna presents many relations to that of the Sunda Isles, and includes four species of rhinoceros (*Rhinoceros sondaicus*, *Rh. indicus*, *Ceratorhinus crossii*, *C. sumatrensis*), the tapir (*Tapirus malayanus*) and *Orcella fluminalis*, a peculiar form of fresh-water dolphin, the anatomy of which has been fully described by Mr. Anderson. The bats hibernate as in Europe, and the genus Taphozous is particularly remarkable for the reservoir of fat stored in its tail for winter use. The roussettes do not hibernate.

Mr. E. W. Oates enumerates seven hundred and seventy-five species of birds, or a hundred more than is contained in all Europe. Of these, four hundred and fifty are also found in Hindostan, about one hundred of which are water-birds common to all the Old World, and winter visitants of Burmah; one hundred and fifty Malayan species, the northern limit of which is in Burmah; fifty species common to Burmah, Siam, and China; and sixty species at present supposed to be peculiar to Burmah. Some species, as *Pavo muticus*, *Megalurus palustris*, *Crypsirhina varians*, are found in Burmah and Java, while absent from Malacca; and species which in Hindostan occur only in the Himalayas at a considerable elevation, are here found at the sea-level. Birds identical with or closely related to those of Europe are few; among them are *Cotyle riparia*, *Chelidon urbica*, *Strix flammea*, the cuckoo, the wrens, the skylark, the pipits, and Saxicola.

The variety of the fauna is explained by that of the country, which is so varied that in an hour one can pass from grassy plains interspersed with rice-fields to the inaccessible precipices of granitic mountains; from a sea of bamboo jungles to the shady retreats of the virgin forest; and from the rich tropical vegetation of the coast to the pine-woods of the heights. Innumerable water-courses, interminable creeks, broad marshes, valleys alternately inundated and dried up; chains of mountains of various elevations diversify the surface of this province, giving it an unequalled array of flowers and fruits, birds, reptiles, insect, and molluscs.

The list of reptiles given by Mr. W. Theobald includes four crocodiles and more than seventy serpents, fifteen of which are among the most deadly, and shows that in this province Malayan and Indian species meet.

Among the fishes are many of those singular forms which seem as much at home on land as in water, such as the tree-climbing *Anabas scandens*, the Ophiocephalidæ and Trichogaster, which have a reservoir of air above their gills; Clarias, with an accessory respiratory apparatus; and Saccobranchus, with its long air-vessel extended across the dorsal muscles and communicating with the gills. The singular modifications of the organs of respiration in these fishes are an adaptation to the æstivation that follows the rains. Some, as *Oph. punctatus*, *Rhynchobdella aculeata*, and *Amphipnous cuchia*, live in summer buried two feet below the surface. After a storm fishes appear as if by magic; the Ophiocephalidæ glide, eel-like, from pond to pond through the wet herbage, and the *cuchia* lies on the ground hidden among the tall weeds, ready to spring into the water when disturbed. Many species, both marine and fresh-water, migrate regularly in accordance with the monsoons. Many mount to the mountain torrents to lay their eggs, and descend with the falling waters, while their young often remain above till the ensuing year. The siluroids of these rapid torrents are provided in their youth with a thoracic adhesive apparatus which disappears in the adult. *Oph. striatus* builds with its tail a nest among the aquatic plants beside the rivers. The nest is formed of the stems of herbs, which it bites off for the purpose; the male guards the eggs, and both take care of the young until they are large enough to go alone, when they chase them, and, it is said, even eat them if they refuse to disperse. The male of *Arius burmanicus* hatches the eggs, from fifteen to twenty, in his mouth, and during the incubation takes no food.

The prosobranchiate Gasteropoda are more numerous and varied in form than those of India; Cyclophoras attains two and a half inches diameter. Pomatias reappears here, and so also does the South American genus Nenia. The conchological fauna of British Burmah shows that the country was primitively an archipelago separated by arms of the sea, for upon the cretaceous hills of the valleys of Salween and Aracan occur isolated species, more numerous and interesting than those of the flat country that separates them. Two hills fifteen miles apart have a different molluscan fauna, and many forms are confined to this region. Besides the, to some extent, special fauna of these hills near Maulmain, three other molluscan faunæ can be distinguished: first, that of Aracan and southern Pegu, considerably resembling that of Assam and of the Himalayas; second, that of Upper Burmah and Thayet, resembling that of India, Central Asia, and China; and, third, that of Tenasserim, allied to that of Siam and the Malay Peninsula and connected with that of the Malayan Archipelago.

Description of a New Species of Wood-Rat from Cerros Island, off Lower California (*Neotoma bryanti* sp. nov.).—Mr. Walter E. Bryant has kindly presented to me the skin and skull of a wood-rat collected by him January 11, 1885, on Cerros Island, off Lower California, in lat. 28° 12′ N.

Concerning its capture he writes as follows: "On the shore of a small, shallow lake, about two thousand feet in altitude, on Cerros Island, I found a nest composed of the large dry leaves of the Maguey plant (*Agave*). It was built among small living plants of the same kind, which held it so firmly that I could not overturn it. It was about four feet high and as much or a little more in diameter at base. One of our party set fire to the structure, and while it was enveloped in flame and smoke a scorched rat ran out, which I shot. This was the only nest and only rat seen on the island."

This unfortunate circumstance, together with the fact that the skin was preserved in brine, explains the very poor condition in which it reached me. Enough remains, however, to show that the species differs remarkably from all known representatives of the genus in possessing a very dark belly, which, in this individual at least, is absolutely concolor with the back and sides. It may be added that the dark color of the under parts is in no way due to the scorching above mentioned. In all the previously described species the belly is pure white, or nearly white, in sharp contrast to the color of the upper parts.

This animal may be distinguished from its congeners by the following characters:

NEOTOMA BRYANTI sp. nov. *Bryant's Wood-Rat.* (Type No. $\frac{2838}{1833}$ male, immature; Merriam Collection.)

Size large, about equal to that of eastern specimens of *N. floridana;* hind foot, 37 mm.; tail naked, its length uncertain, part of it being wanting; ears, apparently about the size of those of eastern *floridana*, but too imperfect to admit of measurement; head, throat, and body all round, dark slate color, almost sooty, exactly the same below as above, without trace of whitish on under parts. The feet may have been white, but it is impossible to tell from this specimen.

Behind each ear there is a patch of fulvous-tipped hairs, and it is possible that a superficial wash of this color was spread over much of the upper parts where the tips of the hairs have been singed off. The skull shows that the animal from which it came was full grown, but not quite adult. The grinding down of the molar teeth has only recently begun; consequently the deep plications along their sides are of unusual length. The enamel of the front upper molar forms two well-marked re-entrant angles of the inner side of the tooth. The pattern of the crowns of the molar teeth in both jaws is the same as in eastern specimens of *floridana* of corresponding age. The incisive foramina extend posteriorly beyond the plane of the anterior roots of the first molars. The pterygoid fossa is narrow, as in all the western forms of the genus,—very unlike its condition in eastern *floridana*. The condyloid process of the mandible is decidedly longer than in any of the other species. The zygomatic breadth is noticeably less than in the other members of the genus, which may be due in part to the immaturity of the individual, the zygomæ usually arching outward with age. The length of the molar series is conspicuously greater than in eastern skulls of *floridana* of the same size, and the molar series are much nearer together. This last character, however, is common to the western representatives of the genus.

Comparison with the western forms of the *floridana* type has been intentionally withheld because of the unsatisfactory if not chaotic condition in which these forms have been left by recent writers.

The new species is named in honor of its discoverer, Mr. Walter E. Bryant, of Oakland, California.

The following cranial measurements will suffice for present purposes (all measurements in millimetres):

Basilar length (from one of the occipital condyles to posterior edge of alveola of incisor of same side)	41.80
Basilar length of Hensel (from inferior lip of foramen magnum to posterior edge of alveola of incisor)	38.20
Occipito-nasal length (from occipital crest in median line to most anterior point of nasals, a measurement of very little value)	45.80
Greatest zygomatic breadth	22.50
Least breadth of frontals at interorbital constriction	5.50
Greatest length of nasal bones	17.70
Greatest width of nasal bones anteriorly	5.
Least width of nasal bones posteriorly	2.10
Least width of rostrum in front of zygomæ	4.80
Distance between outer rims of alveolæ of upper incisors	4.80
Distance from posterior rim of alveola of incisor to anterior rim of alveola of first upper molar	12.50
Distance from posterior rim of alveola of incisor to post-palatal notch ("palatal length")	20.80

Length of upper molar series measured on the alveolæ	10.40
Length of upper molar series measured on the crowns	8.30
Distance between alveolæ of upper molar series anteriorly	2.70
Distance between alveolæ of upper molar series posteriorly	4.40
Width of pterygoid fossa	2.
Apex of post-palatal notch to foramen magnum	17.
Height of cranium from inferior lip of foramen magnum	11.20
Fronto-palatal depth (taken at middle of molar series)	11.80
Greatest length of single mandible (exclusive of incisors)	29.30
Distance from incisors to first molar (on alveolæ)	6.30
Length of under molariform series measured on the alveolæ	9.80

C. Hart Merriam.

Zoological News.—Sponges.—Franz Vejdovsky points out that the recently described *Spongilla glomerata* Noll is the same as *Sp. fragilis* described by Dr. Leidy in 1851, and since described under several different names. He also gives a list of the known fresh-water sponges of Europe, enumerating eight species distributed among the genera Euspongilla, Spongilla, Trochospongilla, Ephydatia, and Carterius.

Echinoderms.—C. F. and P. B. Sarasin describe (*Zool. Anzeiger*, ix. pp. 80–82, 1886) the poison apparatus of the leather-urchin, *Cyanosoma urens*, a new genus and species. From the integument arise slender stalks bearing on their extremities strong connective-tissue poison-sacs.

Hubert Ludwig, in the same journal (p. 472), describes a six radiate condition in *Cucumaria doliolum.* Out of about one hundred and fifty half-grown specimens which he obtained at Naples, five had this peculiar structure, which affected not only the tentacles and ambulacra, but made itself evident in the internal organs. Such variations are extremely rare among the Holothurians.

Worms.—Dr. H. Schauinsland has a note (*Zool. Anzeiger*, ix. 574, 1886) upon the excretory and genital organs of the Priapulidæ, a family of Gephyrean worms, in which he points out that the so-called genital organs of these animals are not simply genital in function, but that, in fact, they are but portions of the ducts of the excretory organs, the epithelium of which gives rise to the genital products. He also states that these worms differ from the other Gephyrea in that the ova and spermatozoa do not escape into the body cavity, but are directly expelled into the sea.

In a paper read before the Linnean Society of New South Wales, June 30, 1886, Mr. J. J. Fletcher described six new species of earth-worms from Australia in addition to the three previously known. Of these, two belonged to the genus Perichæta, two to Notoscolex (a new genus), while two new genera, Didymogaster and Cryptodrilus, are created for the other two. Those previously known belong to the genera Lumbricus, Digaster, and Megascolides.

Prof. R. Ramsay Wright described at the meeting of the

Zoological Society of London, June 29, a new ectoparasitic Trematode under the name *Sphyranura osleri*. In its position it is intermediate between Gyrodactylus and Polystomium, and was found upon Menobranchus.

Molluscs.—Kobelt in a "Nachtrag" to his former papers on the Molluscan fauna of Nassau (*Jahrb. Nassauichen Vereins*, Bd. 39, 1886) reviews, among other molluscs, the Unionidæ of Nassau, and describes, besides several varieties, *Unio rhenanus*, *U. kochii*, and *Margaritana freytagi* as new! Eight plates illustrate the paper.

The rarest of the Cypræas is possibly *Cypræa decipiens*. It was described by Edgar A. Smith in 1880 from a single worn specimen, which until recently was the only one known in any collection. It somewhat resembled a young *C. thersites*, and some had doubts as to the validity of the species. Recently several specimens have been obtained from the pearl-divers of Northwestern Australia, and these show conclusively that the species is a good one. It is said that the large green turtle feeds upon these molluscs.

Usually molluscs are very tolerant of those commensals, the oyster-crabs, which make their homes within their valves. At a recent meeting of the Zoological Society of London, Henry Woodward exhibited a specimen of the pearl-oyster (Meleagrina) from Australia in which a male Pinnotheres was enclosed in a cyst of pearl.

Bednal, in the *Transactions of the Royal Society of South Australia*, enumerates five species of Murex and one of Typhis as being found on those shores.

Crustacea.—Collett, in a paper on Rudolphi's rorqual (*Balænoptera borealis*), records the presence (*Proc. Zool. Soc. London*, 1886) of the parasitic copepod, *Balænophilus unisetus*, on this whale. It is regarded as very rare, and has before been recorded but twice, and then on *Balænoptera sibbaldii*.

Myriapods.—Berlese has a monograph of the Italian Iulids in the seventeenth volume of the *Bulletin of the Italian Entomological Society*.

According to G. Saint-Remy the brain of Scolopendra is much more like that of Hexapods than like that of either Crustacea or Arachnida.

Arachnida.—At a recent meeting of the Entomological Society of Washington, Dr. Marx announced the finding of the European *Epeira diademata* in Minnesota.

At the meeting of the Linnean Society of London, November 18, 1886, Mr. A. D. Michael exhibited specimens of the mite Argus which had been received from Australia, and which were apparently identical with the celebrated *Argus persicus*, the bite of which is said to produce delirium and even fatal results.

EMBRYOLOGY.[1]

Notes on Two Forms of Cestoid Embryos.—While engaged on the systematic study of the entozoa of marine fishes in the laboratory of the United States Fish Commission, Wood's Holl, Massachusetts, I have made notes and sketches of different stages of development of several species of Cestoidea. Without attempting at this time to give a detailed account of any one species, I wish to present a few notes on two forms which are of frequent occurrence.

To illustrate the first I have chosen a cyst taken from the peritoneum of the bluefish (*Pomatomus saltatrix*), and containing an embryo Rhynchobothrium. (Fig. 1.) Cysts like these, either of the same or closely related species, are abundant in most of the Teleostei, and are also occasionally found in Selachians. In the specimen under consideration the length was 12 mm., the breadth at the widest part 6 mm. When removed from its host the following points could be made out. The outer covering or cyst proper was oblong, larger at one end than the other, and tapering uniformly; thin, transparent, and delicate, with yellow granular patches, apparently masses of lymph-cells, on the surface at the larger end. When the cyst was broken open an endocyst (*blastocyst*, Diesing, "Revis. der Ceph. Ab. Param.," Introduction, p. 3) was released. After the escape of the endocyst from its enveloping cyst, the latter retained its shape and was not irritable or contractile. It was easily separable into a thicker outer and thinner inner layer, both hyaline and formed of connective tissue.

The endocyst when released from its capsular envelope was white and opaque, but became translucent, with a faint bluish tinge, when subjected to the action of the compressor and viewed by transmitted light. In form, while somewhat variable, it is usually club-shaped; much larger at one end than the other; the larger end blunt and rounded. The breadth of the larger end is uniform for about one-third the length of the endocyst, at which point there is a sudden constriction, beyond which the breadth diminishes gradually to the smaller end. When placed in sea-water it continues in a state of activity for hours. There is no decided locomotion, but a continuous series of movements, consisting of alternate contraction and extension of different parts of the sac-like mass and feeble lateral movements of the smaller end. In this condition the appearance of the endocyst is that of a thick-walled sac, the walls of which are made up of granular protoplasm with a thin investing membrane, and filled with clear, highly refractile globular masses. When placed under the compressor and slight pressure applied, the embryo Rhynchobothrium could be seen lying in a loose, irregular coil in

[1] Edited by Dr. JOHN A. RYDER, Philadelphia.

the large end of the blastocyst. (Fig. 2.) A sinuous vessel, revealing the existence of a water vascular system, could be plainly seen extending along each edge of the blastocyst, apparently uniting in the median line at the smaller end. At the larger end they seem to be merged in the common parenchyma. In the immediate vicinity of the embryo the blastocyst is more transparent than in other parts, and the embryo seems to be held in position by a limiting membrane which lines the blastocyst and surrounds the embryo. When considerable pressure is applied the embryo is forced through the walls of the larger end of the blastocyst. The parenchyma is then seen to be confined to the thick walls of the blastocyst, as it does not flow out when the walls are ruptured. I succeeded in separating the wall of the blastocyst into two distinct coats, the outer one much thicker than the inner. In the outer coat three distinct layers were distinguishable; an outer granular layer, under which was a layer of longitudinal muscular fibres, and under this a thick layer in which were the characteristic refractile masses. These layers were not separable from each other. The thin inner coat, which was easily separable from the outer, was very delicate and contained a few irregular, flat, granular masses. The presence of transverse muscular fibres was not demonstrated, although their existence was shown by the power which the blastocyst had to contract and expand laterally. They probably lie in the outer granular layer.

The irritability and contractility of the blastocyst continue for several hours after the embryo is removed. In earlier stages of the development of similar forms, before the embryo is clearly outlined within the blastocyst, the individuality of the latter is even more clearly marked, and is strongly suggestive of the Sporocyst of a Trematode with the beginning of a Cercaria at one end. The endocyst or blastocyst may therefore be regarded as an intermediate or transition form, which is probably developed from a six-hooked larva, as in most other Cestoidea, and which, after the manner of a nurse, gives rise to an embryo by internal gemmation. This embryo, when ready to escape from the blastocyst, is a scolex similar in form to the adult, and if transferred to a proper host would develop directly into an adult strobile.

The embryo, when freed from the endocyst (Figs. 3, 3 *a*, and 4), was quite active, and consequently definitely accurate measurements of many of the dimensions were impossible. Its length was about 24 mm., although it was capable of varying this to a considerable degree both by contraction and extension. The bothria are two in number, marginal, oblong, widely divergent behind, approaching each other, but not uniting, in front; notched on the posterior border and obscurely two-lobed; edges free, thin, and mobile. Length of bothria, measured while somewhat flattened under the compressor, 2.23 mm.; breadth of head, compressed, 2.72 mm. Proboscides, four, very long, slender, cylindrical, and armed with recurved hooks of different sizes. The proboscides were not entirely everted, but by counting the series of hooks which are exposed, and allowing for the part which is inverted, which can be plainly seen through the transparent walls of the proboscis, the result is about one hundred series of hooks arranged in spirals. The spirals are nearly 0.05 mm. apart, and the proboscides about 4.80 mm. in length. There are about fifteen longitudinal rows of hooks. These rows do not coincide exactly with the axis of the proboscis, but make about one and a half turns around it from base to apex. The hooks in these longitudinal rows present the following differences. (Fig. 6.) Three contiguous rows have small, recurved, stoutish hooks, which lie in groups of two, one hook immediately in front of the other, and each group of two thus formed corresponding in position with a single hook in each of the other longitudinal series. The central of these three rows does not have the hooks as distinctly placed in groups of two as the two remaining rows. At the bases of the proboscides these hooks are 0.0152 mm. in length, increasing to 0.02 mm. at the apex, with the breadth of base 0.0102 mm. throughout the series. On each side of this group of three longitudinal series lies a series of small, slender, slightly recurved hooks. These hooks are 0.0127 mm. in length at the base of the proboscis, increasing to 0.02 mm. at the apex, with the breadth of base 0.0076 mm. Each hook of these two series corresponds in position to one of the groups of two in the three series first mentioned. The remaining series of hooks are ten in number. It is rather difficult to estimate the exact number of these longitudinal series, since the transverse spirals are not in even curves, but have a slight zigzag or sinuous course, so that the exact number of longitudinal series in a given part of the circumference is not always plainly shown. In one proboscis I counted eleven of these series, but in another, of which I had a plainer view, there were certainly but ten. These hooks are much larger, stouter, and more sharply recurved than those in the other series. The length of one of the largest near the base of the proboscis was 0.0356 mm., with a breadth of base of 0.0254 mm. Towards the apex of the proboscis they are a little longer than this. These larger hooks are not of uniform size, those adjoining the smaller longitudinal series being smaller than those farthest from them. In the transverse spirals formed by these hooks there is a tendency to form two faintly-defined groups of three hooks and one of four, the hooks in these groups of course standing side by side.

The proboscis-sheaths (Fig. 4) are long and spiral. A contractile ligament was clearly defined in each and could be traced out into the proboscis, where it appeared as a tubular band containing a fluid in which floated a few granules. Towards the end this tubular ligament merged imperceptibly into the proboscis, and the fluid interior with granules became the interior of the inverted proboscis, with, at first, small and scattered rod-like hooks, and towards the apex of the inverted proboscis, with normal hooks attached to the inner parietes.

The front end of the long and slender contractile bulbs lies about 10 mm. back of the apex of the head; length 2.46 mm.; breadth 0.24 mm. The contractile bulbs, as in all the Trypanorhyncha, are thick-walled. The walls are composed of diagonal muscular fibres, which interlace, making angles of about 70° and 110° with each other. These organs act in much the same manner as the bulb of a syringe. By their contraction the fluid contents is forced into the proboscis-sheaths and proboscides. The column of fluid thus forced into the proboscides causes them to unroll like the finger of a glove that has been turned in. The contractile ligament, noticed above, extends the entire length of the proboscis-sheath and is attached to the inner parietes of the bulb; by its contraction the proboscis is invaginated from the apex. When the embryo was first liberated the proboscides were entirely retracted; when, however, pressure was applied, they unrolled. In this condition the proboscides are very beautiful objects, being quite transparent, while the chitinous hooks have a brilliant vitreous lustre. When fully extended the proboscides throw themselves into graceful spiral curves. When the pressure is released they are apt to be withdrawn.

The bothria, in life, are transparent, finely granular, with a few scattered, refractile globular masses similar to those in the walls of the blastocyst. The tubular neck, when flattened under the compressor, presents the following features. The centre, surrounding the proboscis-sheaths and extending nearly to the edges, is filled with large, irregular granular masses closely packed together. Outside of this inner core is a layer of longitudinal muscles, and outside of this a layer of vascular tissue, in which the reticulated vessels of the water vascular system can be plainly seen. Outside of this again, and forming the outer coat of the neck, is a layer of dense tissue, which, as nearly as can be ascertained without stained sections, consists of transverse muscular fibres.

The water vascular system consists of a net-work of vessels in the borders of the bothria which connects with large sinuous vessels in the centre of the head, and together with these with the reticulated subcuticular vessels of the neck. Back of the contractile bulbs the system is represented by two pairs of vessels which lie in sinuous curves near each edge of the embryo. One of these vessels was much larger than the others, and ended in a bulbous enlargement.

Behind the contractile bulbs the body has the appearance of an elongated sac, filled with granular parenchyma, but with the refractile masses much smaller than those in the blastocyst, and enclosed in an investing membrane about 0.005 mm. thick. The posterior end is terminated by a papillary, button-like process, which is retractile and covered with a dense coat of minute, straight, hair-like bristles. (Fig. 5.)

Another form of cyst I will notice briefly and illustrate by an embryo Tetrarhynchobothrium, taken from the surface of the liver of the cero (*Cybium regale*). (Fig. 7.) This cyst is long and slender, about 10.5 mm. in length and 1.5 mm. in breadth, yellowish, opaque, but broken in places so as to show the outline of the blastocyst.

The blastocyst, which is set free when the walls of the cyst are ruptured, is long and slender, with a neck-like constriction at one end. (Fig. 8.) The head part thus set off is very changeable in form, expanding, contracting, moving up and down and from side to side, and revolving with a rotary movement on the constricted neck. The longer part or body of the blastocyst also undergoes much change of form by irregular contraction and expansion, but these movements take place more slowly than in the head. The color is ivory-white, slightly translucent when extended.

When compressed the embryo is discovered lying in a coil in the head of the blastocyst. (Fig. 8.) The parenchyma of the head part is now seen to be much coarser than that of the body part, the coarseness being due to the presence of numbers of large, oval, refractile fluid spaces. The parenchyma of the body is dense and finely granular, with smaller refractile masses than those in the head part. When the head part of the blastocyst is broken open the embryo is released, but instead of separating from the blastocyst, as in the case of the embryo Rhynchobothrium, the blastocyst remains attached to the body of the scolex much like the Cystocercus of Tænia. The method of release, however, is quite different from that of the Cystocercus of most Tæniæ. Instead of unfolding like the finger of a glove, the neck of the scolex first emerges in the form of a loop. (Fig. 9.) While in this position the head lies close beside the base of the neck in the vicinity of the contractile bulbs. The head is released by a simple straightening of the neck, which at its base, a short distance back of the contractile bulbs, remains attached to the head part of the blastocyst. (Fig. 11.) In this specimen, after the head of the scolex was released, the anterior part or head of the blastocyst continued for some time working backwards and forwards on the neck of the scolex like a movable barrel on a stationary piston. (Fig. 10.) Considerable pressure was applied for the purpose of making the scolex separate entirely from the blastocyst, but without causing it to break loose. When pressed out as far as it would go, it could be seen that there was an unbroken continuity between the scolex and blastocyst. The posterior tapering end of the scolex, however, was clothed with the straight, fine hair-like bristles noticed in the Rhynchobothrium embryo.

The bothria are four in number, in opposite, lateral pairs, spreading from the front of the head. They are quite mobile, sometimes with the sucking-disks turned forward, sometimes backward, and with a retractile proboscis, armed with long, slender, slightly recurved hooks, belonging to each bothrium. (Figs. 11 *a* and 11 *b*.) The proboscides were everted but a short distance, but they were apparently as fully developed as those in the Rhynchobothrium embryo. The proboscis-sheaths were in spirals and the contractile bulbs slender. A reticulated system of vessels in the margins of the bothria, and sinuous longitudinal vessels behind the contractile bulbs and near the edges of the blastocyst, were made out in the living specimen.

In a specimen which was lightly stained with carmine and placed in glycerine, the scolex and body part of the blastocyst are red, while the globular head-like part of the blastocyst is a golden yellow, the carmine only showing faintly in some longitudinal central vessels, which apparently belong to the water vascular system. This same part in unstained specimens in alcohol is yellowish and more opaque than the body, which is white with a faint bluish tinge.

The development of this form differs at this period from that of the Rhynchobothrium described, in that the blastocyst is retained as a part of the scolex after the latter is released. I have repeatedly tried the experiment of opening blastocysts of these two types, with the results in every case as given above. In the one case, the embryo does not seem to have any vital connection with the blastocyst when the walls of the latter are broken. In the other, the embryo cannot be removed from the blastocyst except by breaking a connecting bond. Whether, in the latter instance, the blastocyst becomes a part of the adult strobile by giving rise to segments by absorption or otherwise, or whether it is evanescent, I have, as yet, had no opportunity of observing. —*Edwin Linton, Wood's Holl, Mass.*, August 31, 1886.

EXPLANATION OF PLATE.

FIG. 1. Cyst from peritoneum of *Pomatomus saltatrix* containing endocyst, enlarged about two diameters.

FIG. 2. Endocyst released from its cyst, somewhat flattened under the compressor so as to show the embryo Rhynchobothrium coiled up in the larger end, enlarged about two diameters.

FIG. 3. Embryo liberated from the endocyst (or blastocyst), lateral view, enlarged three diameters.

FIG. 3 *a*. One of the bothria, isolated, enlarged three diameters.

FIG. 4. The same flattened under the compressor, showing the contractile bulbs, the spiral proboscis-sheaths, and the protruded proboscides, enlarged six diameters.

FIG. 5. Posterior end of same, showing the termination of the vessels of the water vascular system and the fine hair-like bristles on the terminal papilla, enlarged twenty-five diameters.

PLATE X.

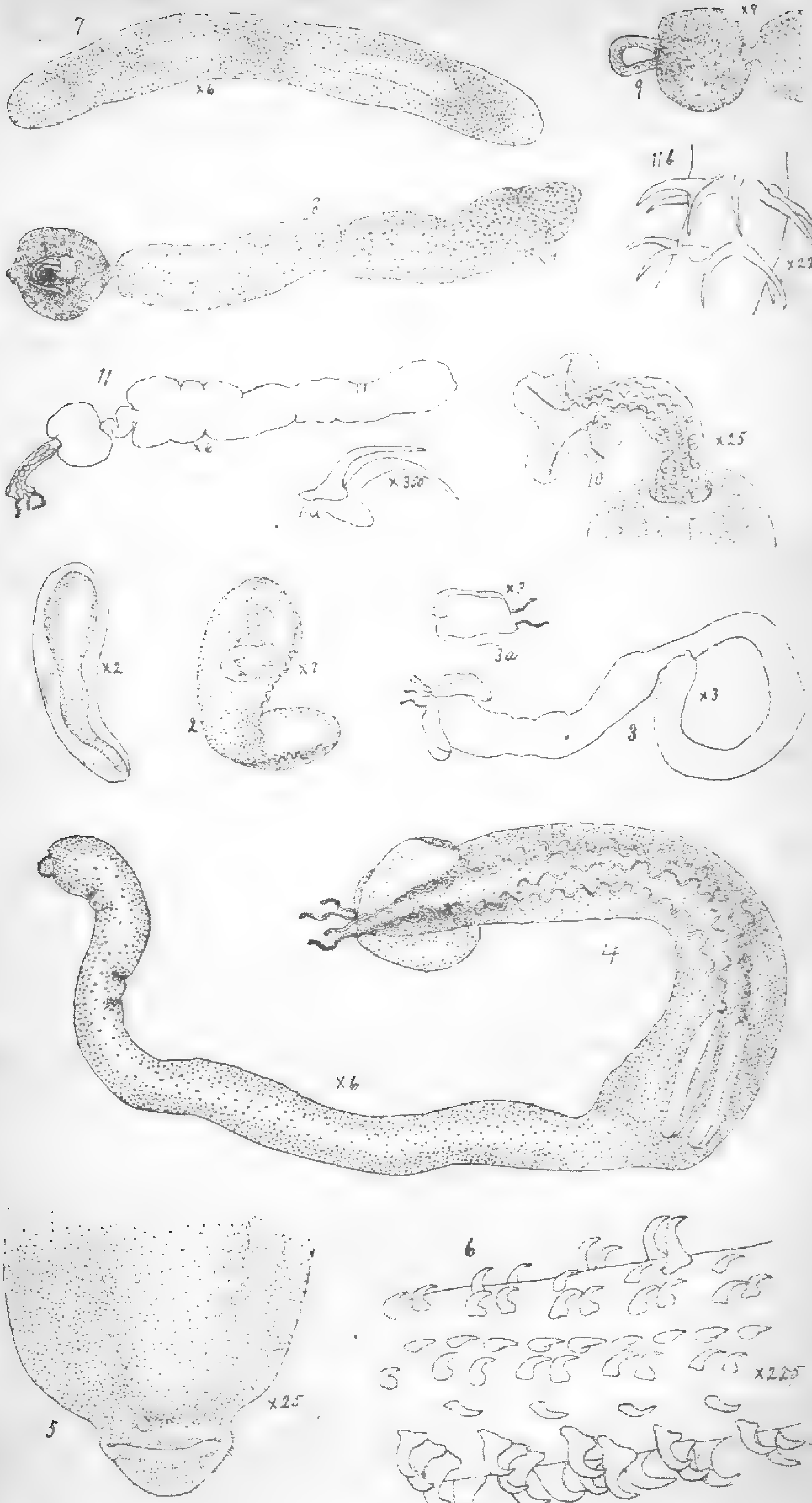
7
x6
9
11b
x225
8
11
x6
x350
11a
10
x25
x2
2
x2
3a
3
x3
4
x6
6
3
x225
5
x25

FIG. 6. Portion of proboscis, showing the five series of smaller hooks in front and a part of the larger hooks at the side, enlarged two hundred and twenty-five diameters.

FIG. 7. Cyst with endocyst, from surface of liver of *Cybium regale*, enlarged six diameters.

FIG. 8. Endocyst (blastocyst) liberated from its cyst, slightly compressed and showing the coiled embryo Tetrarhynchobothrium in the "head," enlarged nine diameters.

FIG. 9. The same, subjected to greater pressure, showing the embryo in the act of escaping from the blastocyst, enlarged nine diameters.

FIG. 10. The same, with head freed from the blastocyst, but still attached posteriorly to the "head" of the blastocyst. The bothria are seen from below as they are spread out and applied to the under glass of the compressor, enlarged twenty-five diameters.

FIG. 11. Outline of embryo with its blastocyst now attached like a rudimentary strobile, enlarged six diameters.

FIG. 11 *a*. Hooks near apex of proboscis, enlarged three hundred and fifty diameters.

FIG. 11 *b*. Portion of proboscis, enlarged two hundred and twenty-five diameters.

All the figures drawn from life by Mrs. Edwin Linton.

Edwin Linton.

Development of Scorpions.—Kowalevsky and Schulgin have a paper on the development of *Androctonus ornatus* in the *Biologisches Centralblatt* (vi. pp. 525–532, 1886) which throws much light on these forms. As long as the egg remains in the ovarium it is not impregnated. Segmentation begins in the uterus. Their earliest embryo had the blastoderm completely formed at one pole of the egg, and at this time no nuclei were to be seen in the yolk. The first appearance of a differentiation into germ-layers was seen in the appearance of a swelling beneath the blastoderm, the cells of which arise from the pre-existing blastoderm cells and sink to the lower layer. This germinal area is circular in outline. The next step consists in the formation of the embryonic envelopes, which arise as a circular duplicature of the blastoderm in a manner analogous to those of Hexapods. Now the germinal area elongates, and one pole (cephalic) retains its breadth while the other (abdominal) becomes thicker and longer. During these processes many cells separate from the lower layer (ento-mesodermal) cells and sink into the yolk. These cells are not regarded as forming any of the tissue of the scorpion, but as digesting or softening the yolk. The entoderm arises as a layer of cells which separate from the ento-mesodermal layer and come to lie close upon the yolk. These rapidly spread over the yolk, which has already been enclosed by the amnion and serosa. The entoderm cells modify the outer layer of the yolk and then take up the modified deutoplasm, at the same time taking on the character of a cylindrical epithelium. The abdomen now grows out, and a portion of the mesenteron extends into it as far as the penultimate segment, where it unites with the proctodeum. The central portion of the mesenteron is latest in being differentiated into the tubular mid-gut and the lobulated liver. The neural surface is outlined first, then the sides and hæmal wall.

The mesoderm is first differentiated when the entoderm separates from the ento-mesodermal layer, but for a long time it lingers in the germinal area. It then segments, and there is a preoral segment which contains a cavity like those of the post-oral series. The somatopleure is thicker than the splanchnopleure. Beyond the cœlom these layers unite and extend themselves dorsally between ecto- and entoderm and the marginal cells, changing their character separate, and become the primary blood-corpuscles. They fill the space on the back of the embryo, which the authors regard as the homologue of the segmentation cavity. Later the mesodermal layers unite—first above and later below—in this cavity, thus forming the central circulatory organ. Both the endothelium and the muscularis of the heart are of mesodermal origin, and even before the union of the layers of either side the histological differentiation of endothelium and muscular layers is evident.

The first traces of the nervous system appear as ectodermal thickenings. In each segment appear, on either side, two elevations. Of these the lateral give rise to the appendages, the median to the ganglia. At first these latter are simple ectodermal thickenings, but soon a rapid process of cell-proliferation takes place—first in the cephalic, then in the body region—in the following manner. In the head there are from fifteen to twenty places, in the other segments from ten to twelve, where this growth takes place. Each has the appearance of a groove, and in section these grooves are seen to be simple cavities which soon disappear by the growth of the bounding cells. In this way a very rapid proliferation is possible, but the authors do not consider the point whether it have any phylogenetic importance. The development of the brain is distinguished from that of the rest of the nervous system in that an accessory fold takes part in its formation. This fold was previously recognized by Metschnikoff in the scorpion and by Balfour in the spiders; it is distinct from the grooves mentioned above. A groove is formed around the periphery of the procephalic lobes, which becomes deeper and finally forms a right and a left cerebral vesicle. Next a second fold arises and forms a pouch on either side, the mouths of which are directed laterally. These are the first traces of the median eyes. The lateral eyes are developed independently, but their history has not been worked out.

The coxal glands, when first seen, appeared as a pair of tubes opening externally at the base of the second (?) pair of feet. Later the tubes were much coiled. Two portions could be distinguished,—an inner, arising from the splanchnopleure and communicating with the cœlom by a broad funnel, and an outer, formed by an ectodermal invagination. The lung-sacs appeared late, as simple inpushings into a space rich with blood-corpuscles.

In this connection the reader is referred to this journal, vols. xix. p. 560; xx. pp. 666, 825, and 862.—*J. S. K.*

Polar Globules in the Crustacea.—The question whether there are polar globules formed in the maturation of the arthropod egg has long remained in doubt, and both Minot and Balfour have suggested that their absence was connected with the existence of parthenogenesis. Several writers have described and figured what might be polar globules, but their observations have contained a considerable element of doubt. Recently, August Weismann (*Zool. Anzeiger*, ix. 570–573, 1886) gives a preliminary account of the studies in this direction made by himself and his pupil, Chiyomatsu Ishikawa, on the parthenogenetic eggs of several Crustacea. In *Polyphemus oculus*, the ripe summer egg forms a polar globule in the normal manner, with a spindelkern, the long axis of which is at right angles to the surface of the egg. Then the egg enters the brood space, and there quickly forms a vitelline membrane. While this is going on the spindle divides, and the polar globule, which contains considerable protoplasm, becomes separated from the egg. This takes place at the animal pole of the egg, and then the inner end of the spindle becomes converted into the segmentation nucleus, and segmentation quickly follows. At the close of the second segmentation the polar globule itself divides and then quickly disappears; the authors think it is absorbed again by the egg. In *Bythotrepes longimanus* the process is much the same, except that the transformation of the proximal end of the spindelkern into the segmentation nucleus has not been seen. At the eight-cell stage the remnants of the polar globules are still visible, sunk between the cells, but with further development of the egg they sink deeper and finally disappear. Grobben had described polar globules in *Moina paradoxa* and Weismann confirms the observation, describing the process of formation as witnessed in the living egg. It does not differ materially from that outlined in the other species. In Leptodora, Weismann found a body very like the polar globules of Polyphemus and Bythotrepes, but did not see the method of their formation. In *Daphnia longispina* the spindle is apparently not so evident as in other cases, but its place is taken by a clear spot about half-way between the pole and the equator. Shortly after this the polar globule appears on the surface, its nucleus frequently retaining traces of the karyokinetic figures of formation while its circular or oblong body remains homogeneous. During the first and second segmentation of the egg the polar globule itself divides, the process being accompanied by karyokinesis and the resulting cells remaining close together. In this species the egg completely fills its envelopes, and hence the polar globules are forced into the soft surface of the yolk, where they are with difficulty visible, at least without reagents. Leydig's observations, a quarter of a century ago, on the eggs of this same species showed bodies which have been supposed to be polar globules; but this could not have been the case, as these bodies which he describes were *outside* the chorion. A full paper is promised in the *Verhandlungen* of the *Freiburg Gesellschaft.—J. S. K.*

ANTHROPOLOGY.

The Races of Men.—A. Hennuyer, of Paris, will publish a series of volumes entitled "Bibliothèque Ethnologique, Histoire Générale des Races humaines." The first volume has already appeared, with the title:

Introduction à l'Étude des Races humaines, by A. de Quatrefages. There will follow:

Les Races Noires, by E. T. Hamy.
Les Races Jaunes, by M. J. Montano.
Les Races Rouges, by Lucien Biart.
History of the Mongols, by Jules Denitar.
Les Foulahs, by Dr. Tautain.
Les Aztèques, by Lucien Biart.

M. Quatrefages perfects the scheme of nature which has already appeared in his work, entitled "L'Espèce humaine," but which may not be familiar to all the readers of the AMERICAN NATURALIST.

EMPIRES.	KINGDOMS.	PHENOMENA.	CAUSES.
Inorganic	Sidereal	Keplerian movement	Gravitation.
	Mineral	Keplerian movement plus physico-chemistry	Gravitation. Etherodynamics.
	Vegetal	Keplerian movement plus physico-chemistry plus vitality	Gravitation. Etherodynamics. Life.
	Animal	Keplerian movement plus physico-chemistry plus vitality plus voluntary motion	Gravitation. Etherodynamics. Life. Animal Spirit.
	Human	Keplerian movement plus physico-chemistry plus vitality plus voluntary motion plus morality and religiosity	Gravitation. Etherodynamics. Life. Animal Spirit. Human Spirit.

The views of monogenists and polygenists are presented in parallel columns, with monogenism as the personal equation of the author. It remains for a polygenist to prepare a similar table with as much fairness.

MONOGENISM.	POLYGENISM.
All men belong to one and the same *species.*	There are several *species* of men.
The differences which distinguish human groups are racial characters.	These differences are like specific characters.

Monogenism.	Polygenism.
At what epoch did this single species appear on the surface of the globe? The question of antiquity is simple.	At what epoch have appeared the different human species? Have they arisen simultaneously or successively? The question of antiquity is multiple.
The human species first occupied only a circumscribed area of the globe. There is, then, a question of geographic origin to resolve.	The different species have first appeared on the spots where history announces their discovery. The question of geographic origin does not exist.
The globe was peopled by migrations of which we have to search the traces and reconstruct the history.	Migrations count for nothing in the general peopling of the earth. The question of primitive migrations exists not. The migrations of which history has preserved the memory are exceptional, and have exercised only an insignificant influence over the geographical distribution of peoples.
To-day there probably exists no autochthonous people. America, in particular, and Polynesia were peopled only by colonists.	Excepting the European colonies founded in our day and those recorded in history, almost the entire globe has been peopled by autochthones. Specially, all the peoples of America and Polynesia were and could only be the products of the soil where modern explorers have found them.
The human species inhabits to-day the entire globe,—the pole as well as the equator. It has, therefore, subjected itself to environments the most diverse. The question of acclimating in its widest and in its most special sense is necessarily raised.	The human peoples, constituting so many species originating on the spot, were made to live in the environments which encompass them. There is no general question of acclimating. We have only to study the special cases resulting from the expansion of modern populations.
In these migrations the human species, exposed to the action of new environments, could but be modified. This explains the formation of a certain number of races. Facts of the same nature passing in our day ought to arrest in a special manner the attention of anthropologists.	The different human species have appeared with all the characteristics now marking them. Change of environment could not alter these. We have not to search how these distinctive characters could be brought out.
Crosses between human races in the past have given rise to races whose origin has been revealed by mixed characters imprinted by the parent types. We have to search the ethnic elements combined in peoples of this class.	Populations with mixed characters are like the rest, distinct species and autochthonous. One need not disturb himself, therefore, about their pretended ethnic origins.
Crosses between human races most diverse take place under our eyes. They have given birth to populations which enlarge from day to day and become more and more developed. The study of these populations presents a double and serious interest, in that it teaches us concerning the past and permits us to look into the future.	Crosses among human species can have no durable consequences. The resulting peoples would remain stationary or disappear if the crossing ceased. Their study possesses, therefore, no serious interest for us.
All actual populations have been more or less modified, either by environment or by crossing. The primitive type of humanity is lost. Even did it now exist we could not recognize it, in default of knowledge. Nevertheless, is it not possible to trace out some of the marks which would characterize it?	All the human species having appeared with their appropriate characters, such as we now recognize them, the problem of primitive man has no existence.

Some of the burning questions which M. Quatrefages discusses are the following:

The pretended Simian origin of man.

Incompatibility of Darwinism and polygenism.

Impossibility of going back to the first origin of the species.

The survival of fossil human races.

In his general treatment of his theme M. Quatrefages has followed the method of Prichard.

The Deities of the Navajos.—In the interesting account entitled "Some Deities and Demons of the Navajos," by Dr. W. Matthews, in the October issue of THE NATURALIST, he mentions the fact that the warriors offered their sacrifices at the sacred shrine of Thoyetli, in the San Juan valley. He says that the Navajos have a tradition that the gods of war, or sacred brothers, still dwell at Thoyetli, and their reflection is sometimes seen on the San Juan River. Dr. Matthews is certain the last part is due to some natural phenomenon. The following account seems to furnish a complete explanation of this last part of the myth. Several years ago, a clergyman, while travelling in the San Juan valley, noticed a curious phenomenon while gazing down upon the San Juan River as it flowed through a deep canyon. Mists began to arise, and soon he saw the shadows of himself and companions reflected near the surface of the river and surrounded by a circular rainbow, the "circle of Ulloa." They jumped, moved away, and performed a number of exercises, to be certain that the figures were their reflections, and the figures responded. There was but slight color in the rainbow. Similar reflections have no doubt caused the superstitious Indians to consider these reflections as those of their deities.—*G. A. Brennan, Roseland, Cook County, Ill.*, January 12, 1887.

Dr. Franz Boas, the successful explorer of the polar countries north of Hudson's Bay, has just returned to the East from a three months' trip to the east side of Vancouver's Island, B. C., and the mainland opposite. He visited there a considerable number of tribes, most of which, he thinks, belong to the Selish family, though he entertains doubts whether the Kwákiūtl belong there or not. As far as their intercourse with the whites is concerned, they are harmless and friendly; but outside of Nanaimo and Victoria the white population there is very sparse. The Gospels of Matthew and John have been translated into the Kwákiūtl language of Fort Rupert, a post now abandoned. Dr. Boas intends to publish soon a part of his exploratory results in this country, with illustrations. A pamphlet upon the Bilkúla, or Vilxúla, farther north, of whom he saw some individuals in Germany, was issued by him, with photographic portraits of these Indians, in the *Transactions of the Anthropologic Society of Berlin.* He pays more attention than explorers commonly do to the collecting of myths, traditions, and vocabularies. To get these he was obliged to avail himself of the Chinook jargon, which he has mastered in a pretty short lapse of time. The songs and melodies which Professor C. Stumpf, of Halle, obtained from the Bilkúla Indians travelling in Germany were published by him in an article inserted in the *Zeitschr. für Musikwissenschaft,* 1886, pp. 405–426, and two articles by Dr. Boas (with another by Goeken) upon the same tribe are to be found in the "Original-Mittheilungen der Ethnolog. Abtheilung der Kön. Museen zu Berlin," 1886, pp. 177–186.—*A. S. Gatschet.*

MICROSCOPY.[1]

Note on the Practical Study of Moulds.—It is well known that the study of moulds may be greatly facilitated by following their development in gelatine films, or other solid substrata, spread on glass slides; but the value of the method for classes in elementary biology has not been sufficiently recognized. The following application of the method is perhaps already in use; but I wish to call attention to it as simple and practical, and especially as affording a ready means of making very clear and beautiful permanent preparations.

The spores are sown with a needle-point in films, consisting of a modification of Pasteur's or Mayer's fluid (with pepsin) thickened with Iceland moss. In this medium moulds grow freely in the moist chamber. They may be examined either fresh or after treatment with iodine, which scarcely colors the substratum. For the purpose of making permanent preparations the culture-slides are transferred directly from the moist chamber to a saturated solution of eosin in ninety-five per cent. of alcohol, a fluid by which the moulds are at once fixed and stained. After twenty-four hours (or, preferably, three or four days) the preparations are washed in ninety-five per cent. alcohol until the color nearly disappears from the substratum, cleared with oil of cloves, and mounted in balsam. All stages may thus be prepared. The mycelia, conidia, etc., appear of an intense red color, while the substratum is scarcely stained. Alcoholic fuchsin may be used instead of eosin, though inferior to it; but other dyes (of which a considerable number have been tested) color the substratum uniformly with the moulds, and are therefore useless. Eosin preparations made more than a year ago do not yet show the slightest alteration of color. The best results have thus far been obtained with *Penicillium*, *Eurotium*, and certain parasitic forms. *Mucor* gives less satisfactory preparations, since it is always more or less shrunken by the alcohol. Fair preparations of yeast may be made by mixing it with the liquefied medium and spreading the mixture on glass slides, which, after solidification of the films,

[1] Edited by C. O. Whitman, Ph.D., Milwaukee, Wisconsin.

are placed in the eosin solution, as in the case of mould-cultures.

For preparing the cultures, Pasteur's or Mayer's fluid, with pepsin [see Huxley and Martin's Practical Biology], but not containing more than five per cent. of sugar, is heated with Iceland moss until the mixture attains such a consistency that it will just solidify when cold (fifteen to thirty minutes). It is then filtered by means of a hot filter into small glass flasks, which are afterwards plugged with cotton-wool, and sterilized at 65° to 70° C. by the ordinary method. When required for use, the mass is liquefied by gentle heat, poured on the slides, and allowed to solidify. The spores are sown by a needle-point, touched once to a mass of spores, and thereupon drawn across several films in succession, the spores being thus scattered along the track of the needle, and more or less completely isolated. Care must be taken that the quantity of sugar be not too great. The films should be tolerably thick, and the atmosphere of the moist chamber such that the films neither dry nor liquefy.

[My thanks are due to Miss Harriet Randolph, whose experiments with various substrata and staining-fluids led to the adoption of the method described].—*Edmund B. Wilson, Biological Laboratory of Bryn Mawr College.*

SCIENTIFIC NEWS.

—W. Baldwin Spencer, of Lincoln College, Oxford, has been appointed to the chair of Biology in the University of Melbourne. He is a pupil of Professor H. N. Moseley. He has published papers on the urinary organs of Amphipods and on the neurenteric canal of the Batrachia, but probably his best known work is that in which he shows that the pineal gland is the remains of the third vertebrate eye, and that in certain existing lizards it still retains all of its optical structure, though it is probably not functional.

—The Buffalo Society of Natural Science is at last provided with suitable quarters. It has long occupied rooms in the old building of the Young Men's Association of Buffalo, but they have been inadequate for the accommodation of the library and collections. The Young Men's Association has also been cramped for room, and a few years ago they began the erection of a new building, which has at last been completed, at a cost of about three hundred thousand dollars. It occupies a very eligible site, and architecturally would be an ornament to any city. The building was dedicated with appropriate ceremonies Monday evening, February 7. It will be occupied by the Buffalo Library, the Buffalo Historical Society, the Buffalo Academy of Fine Arts, and the Buffalo Society of Natural Science. The latter society have ample accommodations in the western portion of the basement. Professor D. S. Kellicott, the president of the Society of Natural Science, gave the address for that society. This society was organized in December, 1861, and its history has been one of continual progress. It has accumulated a fine museum, which is especially rich in local forms. The collection of fossils of the Waterlime group is noteworthy. Nowhere in America can be seen a better collection of Eurypterids, those strange Limulus-like forms which were a prominent feature in the Palæozoic seas. The first president, the late Judge Clinton, gave the society his valuable herbarium, while its entomological collection contains many of the type-specimens of the late Colman T. Robinson, A. R. Grote, L. F. Hervey, D. S. Kellicott, and others. The library is especially rich in entomological works. At present the society is somewhat cramped for funds, but in time it will be amply provided with money. Its late president, Dr. George E. Hayes, left about two hundred thousand dollars, which, after the death of his widow, are to come into the possession of the society. At present its funds are principally from the bequest of the late Professor C. T. Robinson. We are glad to learn that the meetings of the society have never been better attended or the discussions and papers more interesting than at present.

—The Johns Hopkins University will have its marine laboratory this year at Nassau, N. P. The party will sail about March 1, and will stay until July 1, if not longer. It is proposed to hire a building for the laboratory. Dr. W. K. Brooks will be in charge as usual.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—January 19, 1887.—On account of the inclemency of the weather the regular paper of the evening was postponed, and Dr. J. S. Kingsley gave some of his recent observations on the embryology of Arthropods. A peculiar feature was noticed in the development of Decapods, in that the germ from the eyes to the tip of the abdomen was actually longer in early than in later stages. An explanation of this fact is difficult. Dr. Kingsley also referred to the classification of Arthropods and their derivation from Worms. Dr. C. S. Minot gave a *résumé* of observations on the origin of the tracheæ of Hexapods, and suggested that they supported Dr. Kingsley's view that these organs were not homologous in Arachnids and Hexapods. Professor W. T. Sedgwick spoke of the extrusion of trichocysts in Paramecium under the stimulation of tannic acid.

February 2.—Dr. Kingsley gave his paper postponed from the preceding meeting. He maintained that the terms "centrolecithal" as applied to Arthropod eggs, and "superficial" as describing their segmentation, were totally erroneous. A superficial segmentation is of necessity meroblastic. In Arthropod eggs the first segmentations are central, and the blastoderm is formed by migration of the resulting cells to the surface. With this new view it is a comparatively easy matter to reconcile the process of gastrulation in the Hexapods with that of other Metazoa. It affords an excellent example of the theory of acceleration, or concentration of development, held by Professors Cope and Hyatt. The nauplius of Crustacea was regarded as an adaptive stage, and one which had far less phylogenetic significance than was usually assigned it. Professor Hyatt spoke of the early development of the sponges, and instanced cases which paralleled and supported the views of Dr. Kingsley.

General meeting, Wednesday evening, February 16.—The following papers were read: "On the Range of Variations in the Human Shoulder-Blade," by Dr. Thomas Dwight; "A Study of North American Geraniaceæ," by Professor Wm. Trelease.

Middlesex [Mass.] Institute.—January 19, 1887.—Mr. Frank S. Collins read a paper on "Curious Conceits of the Older Herbalists," quoting from Gerarde and earlier writers.

New York Academy of Sciences.—Monday evening, February 7.—The following paper was read: "Report upon the Pink Dolomite recently obtained near Morrisania, with Analysis," by Mr. A. B. Bjerregaard.

Monday evening, February 14.—The following paper was read: "The Landskibet, or Viking Ship, discovered near Gokstad, Norway, in 1880" (with lantern illustration), by Dr. John S. White.

Biological Society of Washington.—February 5, 1887.—The following communications were read: Mr. William T. Hornaday, "The Last of the Buffalo;" Mr. Richard Rathbun, "Ocean Temperature Charts in Connection with Studies in Geographical Distribution;" Dr. C. Hart Merriam, "Contributions to North American Mammalogy. Description of a New Species of Wood-Rat" (*Neotoma*); Mr. Henry W. Elliott, "Ridgeway's Nomenclature of Colors for Naturalists;" Dr. L. Stejneger, "Exhibition of New Species of Birds from the Sandwich Islands;" Dr. Tarleton H. Bean, "Variation under Domestication of the Rainbow Trout" (with exhibition of specimens).

February 19.—The following communications were read: Professor E. D. Cope, "An Undescribed Species of Snake from the District of Columbia;" Professor E. D. Cope, "The Hyoid Apparatus in the Urodele Batrachians;" Dr. George Vasey, "Remarks on a Recent Collection of Mexican Grasses, made by Dr. E. Palmer;" Professor R. E. C. Stearns, "Notes on Physianthus as a Moth-trap."

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THE MASSASAUGA AND ITS HABITS.

BY O. P. HAY, M.A.

NOTWITHSTANDING the almost universal dislike entertained by people for snakes, the horror even that the sight of them excites in some minds, and the low value generally placed on ophidian intelligence, the more unprejudiced attention that has been bestowed by a few persons on these animals within recent years has shown that there is, after all, much to be said in their favor. Their lithe forms, their active and graceful movements, and their frequently brilliant and variegated colors, would at all times have rendered them attractive objects had not the possession of these qualities been more than offset by the actual or supposed possession of others of a disagreeable or dangerous nature. A closer acquaintance with snakes dispels many of our old prejudices against them, as being animals degraded in structure, malicious in disposition, and as laboring under a special curse; and presents them to us as possessors of many singular adaptations to their environment, many sagacious habits relating to the preservation of themselves and of their young, and sometimes of considerable conjugal and parental affection; and, by inference, enjoying as much of the favor of Heaven as most animals. That very interesting work by Miss C. C. Hopley, entitled "Snakes; Curiosities and Wonders of Serpent Life," will doubtless do much to remove unreasonable prepossessions against these persecuted animals, and to awaken greater interest in them and their ways. When we have learned more about them, we may discover that He who "spake with *authority*" also spake as having knowledge of nature when He used the words, "as wise as a serpent."

At present far too little is known concerning the life-history of the great majority of our snakes. Of the breeding habits of many species and large groups of species we know little or nothing, and it is to be desired therefore that accurate observations should be made and reported. I hope in this paper to contribute something to the knowledge of the Prairie Rattlesnake, or Massasauga (*Caudisona tergemina*).

This venomous serpent ranges from Ohio to Utah. Towards the north it extends into Michigan, Wisconsin, and to the Yellowstone River. It has also been found in Georgia and in Mississippi; but it appears to be replaced in the greater part of the South by *Caudisona miliaria*. Its general color above is from gray to brown, with seven rows of dark spots which have a light margin. The belly is mottled with black and yellowish. In Ohio and some parts of Indiana black specimens are sometimes found, and to these the name "Black Massasauga" has been given. Specimens of these were described by Holbrook as *Crotalophorus kirtlandii* in honor of Dr. J. P. Kirtland, their discoverer. Professor S. F. Baird also regarded this form as a distinct species; but of late herpetologists are not inclined to consider it as worthy of even varietal distinction. That the spotted form is ever found in wooded lands I do not know; but the black form, both in Ohio and Indiana, lives in swampy lands which are overgrown with brush, weeds, and coarse grass, and not on the open prairies.

Some of Dr. Kirtland's statements concerning the Black Massasauga are, I think, to be taken with some grains of allowance. With reference to its bite he has, it appears, asserted that its virulence is scarcely greater than that of the sting of a hornet. There are probably no differences, as respects virulence, between this snake and the more common pale and spotted form living on the open prairies, and where the latter is best known it is much feared; and certainly the effects of its bite on the large domestic animals are very serious. The members of this species are probably as poisonous as are individuals of equal size belonging to any of the other species; and since specimens of the Massasauga frequently attain a length of two feet and more, one of them would probably be equivalent in virulence to a whole colony of hornets.

Some twenty-five or thirty years ago this species was excessively abundant on the then sparsely-settled prairies of Northern Illinois; and among the farmers' boys of that day the slaughter of these snakes furnished a means for establishing a reputation for courage and enterprise. As more and more of the land came under cultivation, these serpents rapidly disappeared; so that, where they were once so numerous, they have scarcely been seen for perhaps twenty years. The reasons for this rapid extinction are, I think, not clear. Men, hogs, deer, and the larger wild fowl are regarded as the principal enemies of the Crotalidæ. Of course every man and boy attacked and killed every rattlesnake that was seen; but so likewise they did with every harmless snake; and the species of the latter have not usually suffered to the same extent as the rattlesnakes.

The members of the hog family are the foes of the venomous, and perhaps also of the non-venomous, serpents; but in the districts to which I refer the production of wheat, oats, and corn was at that time so exclusively pursued that but few hogs were raised, and these few were kept shut up in close pens, and thus prevented from exercising any influence on the reptilian fauna. Of their other enemies, the deer were early exterminated, and the native large wild birds, which may possibly have been addicted to devouring the young snakes, were by the "murdering guns" soon greatly reduced in numbers. That the mere disturbance of the soil in cultivation would be more prejudicial to the welfare of the rattlesnakes than to that of other species of serpents we do not know. Possibly, being heavy and clumsy animals, they would find it difficult to move about over cultivated fields and pursue there their vocation, and would abandon them. In this connection it might be profitable to study the influence of similar changes of environment on the Heterodons. It appears to me quite probable, however, that as the country became more thickly settled, the rattlesnakes were deprived to a considerable extent of their opportunities for securing food. In primitive times the prairies were the breeding-grounds of great numbers of prairie-hens (*Cupidonia cupido*) and other ground-nesting birds, whose young and possibly also eggs contributed largely to the support of the various species of snakes. The cultivation of the land interfered greatly with the breeding of these birds, and the prairie-hens were soon thinned out by the hunters, and thus the resources of the venomous snakes were greatly reduced.

The assertion that the sound of the rattle of the Massasauga is so feeble that it is scarcely audible is certainly incorrect. From experience I know that it can be heard at a distance of several feet.

The purpose of the rattle of the Crotalidæ has exercised the ingenuity of many minds and called forth many conjectures. The old notion that it was intended as a means of preserving man from the bite of the snake does not meet the requirements of the case. The organs of animals and plants are designed for the benefit of their possessors, and not for the benefit of some other organism. The somewhat close resemblance of the whirr of the rattle to the song of some grasshoppers has suggested to some one the idea that it is produced in order to lure within reach of the snake some of the grasshopper-eating birds. This hypothesis seems to lack the necessary basis of observation. No one probably has yet heard hungry rattlesnakes in imprisonment sounding the rattle in the vain hope of securing food. Nor is there any more evidence to prove that it is of use in bringing the sexes together. The anal scent-glands would seem to be far more efficient for that purpose. The sexes once together, it is quite possible that their emotions may be expressed by the low humming of the rattle that has been observed. Mr. Darwin concluded that the crepitation produced by the organ is used to frighten away the many birds and beasts that are liable to attack the snake. The means adopted to produce this result ought, then, to be regarded as a signal failure, for no man, or hog, or deer, or ravenous bird, that had resolved to attack a serpent, would probably be deterred therefrom by such impotent demonstrations. If the inspiration of fear were their purpose, we might expect the serpent to elevate itself like the cobra, or make other threatening movements, whereas the rattlesnake lies almost motionless in a coil, meanwhile sounding its rattle, a model of repose born of a consciousness of the possession of reserve power.

The opinion that is generally held that the rattle is sounded as a warning to some enemy which the snake has reason to fear is, I think, the correct one, notwithstanding all that has been said against it. Dr. Elliott Coues has concluded that "the actual result of its use as a menace in self-defence is the reverse of beneficial to the serpent, since the sound serves to direct and provoke attack from all the enemies which the animal has reason to fear." We are led to wonder how the rattlesnakes have been enabled to maintain themselves in the struggle for existence. In spite of the possession of this organ, thus pronounced to be of no use to them, and constantly betraying them into the hands of their enemies, the rattlesnakes have succeeded in diffusing themselves over most of the western hemisphere, in adapting themselves to many varied conditions, and in producing many species and an excessive number of individuals. On the other hand, the Copperheads and Cottonmouths, in possession of all the advantages enjoyed by the rattlesnakes in the way of poison-glands and fangs and relieved of the so-called disadvantage of the rattle, have neither extended their range so widely, nor developed into so many species, nor perhaps become so abundant in individuals.

Nothing can be more certain than the fact that the rattle is used chiefly when the snake is alarmed or angry. The whirr then serves to warn an approaching enemy that it is coming into collision with a rattlesnake, and not with something else. This is done for the special benefit of the snake. It is not benevolent, but intensely selfish. It is evidently extremely solicitous for its precious store of poison and its battery of fangs, without which it would fare slenderly in its endeavors to get a living; and if it can induce its antagonist to withdraw, the snake will have saved its stores and have escaped other possible results of a pitched battle. This warning must have been very efficient with most animals. In the eastern United States there were no native species of the hog tribe to devour snakes. To what extent deer are accustomed to destroy rattlesnakes we do not know. It appears to me that the rattlesnakes had more to fear from the numerous buffaloes that roamed over the greater part of the continent than from any animals that made direct war on them. The serpents must have been in frequent danger of being trodden upon by these, and to have attempted a war on a herd of large animals would have been useless. But through the simple device of sounding the rattle, each animal as it approached would be warned of the presence of the snake and would probably be induced to give it abundant space. Thus the poison might be reserved for such as could not take a hint. Doubtless, too, by this means, the snake was saved from many a rude tread by bear, or wolf, or panther, that to the serpent would at least have been very unpleasant, and might have involved it in a fight in which it had everything to lose and nothing to gain.

Within the past few weeks some specimens of the Massasauga have come under my notice, whose history may throw some light on the breeding habits of this species, as well as on some other matters that have been discussed. These specimens belonged to the black variety, and were captured in the northern part of Hendricks County, Indiana, by Mr. M. B. Harvey, of Rainstown. This gentleman's truthfulness is testified to by friends in whom I have complete confidence, and his statements are made with such sincerity and carefulness that I have no hesitation whatever in accepting them.

The specimens, two in number, one about two feet long, the other somewhat less, both dull black without trace of spots above, were captured about the 1st of last August and kept in close confinement. They were found in an old swampy clearing that was somewhat overgrown with brush. About the 1st of September they both brought forth living young,—one five and the other six,—the two broods appearing within thirty or forty hours of each other. Two of the young died when about three weeks old; the others are still alive (January 28) and in apparent health. Neither the parents since their capture nor the young since their birth had had, up to January 1, anything either to eat or to drink. About the latter date the corner of the box containing them was put into a vessel of water, and one old one and one young one partook. With this exception none have had either food or water up to the present time. Mr. Harvey states that at first the young were but three or four inches long. Some of them are now at least ten inches long, as I know from observation. Others are somewhat smaller. How can this growth have been made? It is possible, I think, that the gentleman has been somewhat mistaken as to the original size; or some of them may have been that small, while others not specially observed were larger. A specimen of the light-colored variety in my possession, which was taken from the mother but which had the fangs developed, measures, when outstretched, five and a half inches. It was hardened in alcohol while spirally twisted within the egg-membranes, and would when born probably have been somewhat longer. However, it is quite evident that Mr. Harvey's specimens have made some growth. Having at hand another alcoholic specimen, seven and a half inches long, which probably had not long been born at the time of its capture, and observing in the posterior portion of its body a hard lump, it occurred to me to open the abdomen and see what the young snake had eaten. The whole intestine was empty, and the hard lump consisted of an elongated mass of egg-yolk two and a half inches long and about three-eighths of an inch in diameter. On such a store of highly-nutritious materials doubtless the young are accustomed to subsist and grow until they are able to capture their own food.

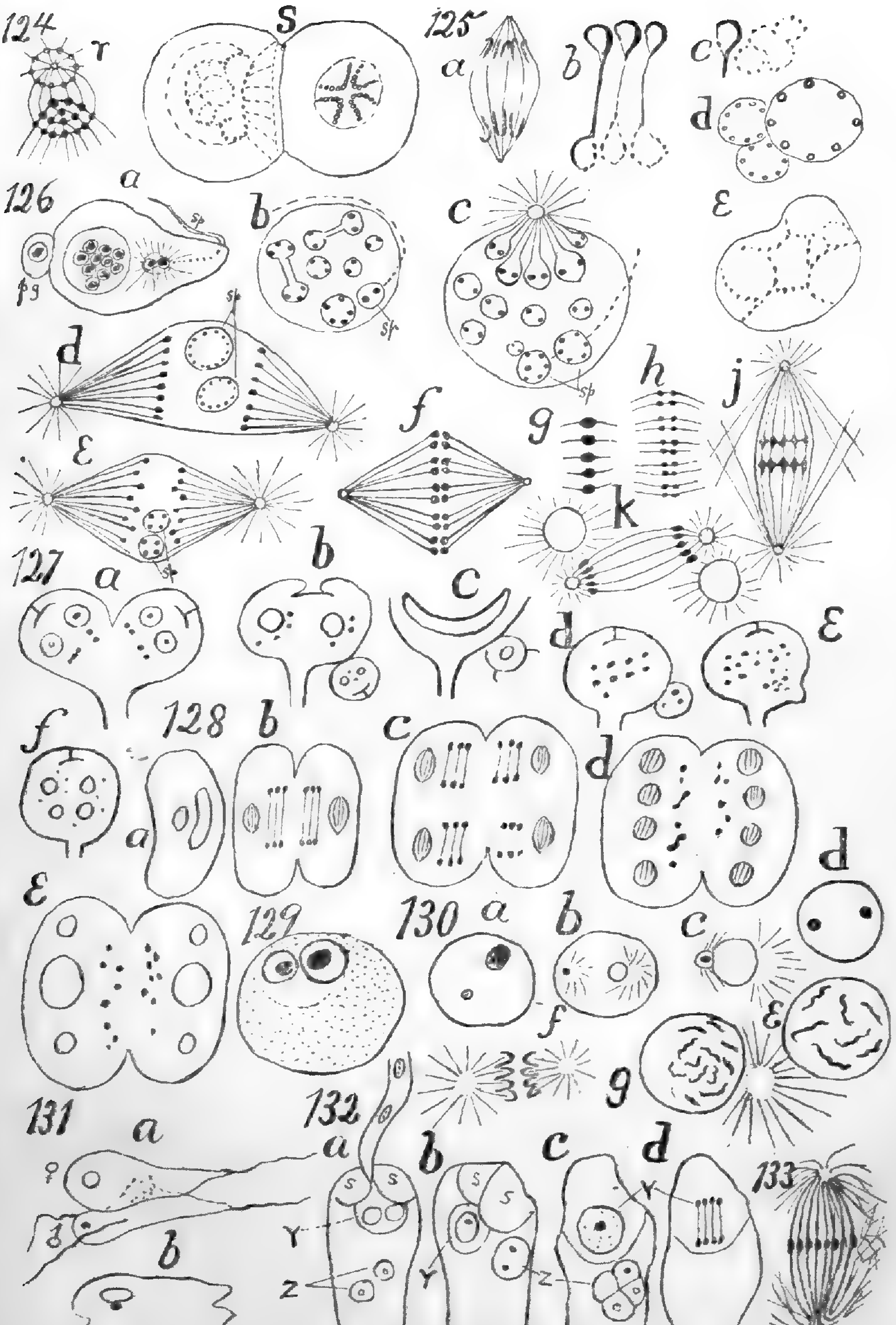
The question whether or not the young ever enter the mother's mouth and stomach for refuge from danger and are permitted to come forth again has been much discussed. It would seem that the results of Mr. Goode's inquiries ought to have settled the question, but there are still many sceptical persons. In the issue of *Nature* for December 24, 1885, a writer, in discussing the case of *Pelias berus*, suggests as an explanation of what has been observed, that possibly the young in their fright, against the mother's will, rush into her mouth as they would into any other opening that might present itself; and that once having entered the stomach they may either never leave it again alive, or they may act there as an emetic and be violently ejected! Now, Mr. Harvey states that his young snakes were accustomed, from their birth up to the time they were a month old, to pass freely into and out of the mothers' mouths. He does not know that they were ever all in the mothers' stomachs at the same moment, but sometimes three or four of them would be missing at once. Sometimes one would be seen going down the throat while another was coming out. Occasionally one might be seen with his head sticking out of one corner of the mother's mouth like a cigar, while in the other corner would be another's head or possibly tail. In describing the mother's movements, Mr. Harvey says, in a letter, that "the mother would sometimes lay her lower jaw on the floor, raise her upper jaw and with it her entire backbone, thus adjusting herself for them to play in and out. . . . They seemed to go in the full length of the stomach." When the young were about a month old they sloughed their skins, and after that event they were never observed to enter the mother's mouth, though they may have done so.

The maternal instinct must be very strong in these reptiles, usually regarded as so low in intelligence and so unfeeling, when they will for weeks and months endure hunger and thirst and still continue to care for their young. One might readily suppose that if the young ever entered the mother's stomach, the temptation would, under the circumstances, be almost irresistible for her to keep them there. When I first saw these specimens, about January 1, the old and most of the young were coiled up together as if for the purpose of keeping themselves warm. The heads of all the young ones were lying out on top of the coils, as if they were as desirous of seeing what was going on as are other young folks. One little one, however, was away from the others on the bottom of the box. One of the mothers appeared to take great interest in it, and kept rubbing it with her head and pushing it gently about with her snout. Mr. Harvey states that the mothers have been accustomed in various ways to show their affection for their young. "The mother would raise her head, turn it about and look over the young, place her nose against them, push them about, and pull them to her side."

The old ones have not shed their outer skins since their captivity began. Since they appear to change their dress twice a year, it is quite likely that this was accomplished just before they were captured. One young one who was watched got rid of his cuticle in about twenty minutes from the time that it was seen to be loose on his head.

Most of the young are quite dark in color, but all have plain indications of the rows of spots usually found in the species, and one has the ground color so pale that it closely resembles the young of the specimens found on the open prairies.

PLATE XI.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133

THE SIGNIFICANCE OF SEX.

BY JULIUS NELSON.

(Concluded from page 162.)

PLATE XI.

FIG. 125, *a–e*. From the segmenting egg of the *Axolotl*—Bellonci, Arch. Italiennes de Biol., vi.—Shows how the knäuel reticulum is formed from the loops. The loops in this case are hook-shaped, or almost straight rods, the end of the segment which first reaches the pole swells out and the chromatin breaks up into microsomata, the whole segment is thus transformed into a vesicle containing peripheral microsomata. These vesicles fuse as in *c*, *d*, *e*, and the microsomata become arranged in rows, which thus form a reticulating filament.

FIG. 126, *a–k*. Fertilization of ovum of *Arion empiricorum*—Platner, A. m. A., xxvii.—In *a* we see the polar globule (*pg*) and the spermatozoon (*sp*), whose head and neck have penetrated into the egg, but left the tail free. The head consists of a hyaline material holding two karyosomata. As usual astral rays surround it. The germinal vesicle contains many karyosomata, each with a hyaline envelope. The head of the spermatozoon at last becomes included in the germinal vesicle. In *b* we see the karyosomata have broken up into many microsomata arranged at the periphery of each hyaline vesicle, they fuse, so that for the most part, as in *c*, each shall contain two microsomata at opposite sides. But the hyaline vesicles themselves fuse (or divide?) as indicated by the dumb-bell forms in *b*. The hyaline mass of the male pronucleus divides, so each half has a karyosoma, and the latter passes through the same stages of segmentation and fusion as the female karyosoma, except that each vesicle has finally four microsomata instead of two (*c*, *d*, *e sp*). [Only the germinal vesicle or its contents are shown in all figures except *a*.] On the side of the germinal vesicle towards the centre of the egg there arises an aster (*c*), and some of the hyaline vesicles become club-shaped and send out stalks and put themselves into connection with it, the membrane of the germinal vesicle disappearing at this point. In *d* a second aster has arisen, also near the first, so that the two are not at first opposite each other, but become so more and more by swinging around into a right line, and as they do so the germinal vesicle sinks towards the interior of the egg; the remaining microsomata, like the first lot, now become connected with this aster, except that the male karyosomata are behindhand (*d*, *e*), but finally these also join. Meanwhile the microsomata become regularly disposed in an equatorial plate and grouped in fours, each pair of a four being united by a spindle-fibre to its own pole (*f*). Then each group of four microsomata fuse to form one karyosoma on each fibre (*g*), and again segmenting into four (*h*), they separate, leaving connecting fibrils between them. As the microsomata move polewards there is a stage, as usual, where they seem to fuse laterally (*j*). In *k* we see the spindle turned out of its position, leaving the two large polar asters *in situ*, but still possessing little ones of its own. Such is the history of the first segmentation after fertilization. By comparing it on the one side with Fig. 124, and on the other with Fig. 127, it is seen to form a connecting link.

FIG. 127, *a–f*. A case of conjugation with *Vorticella microstomum*—Engelmann, M. J., i.—When division or budding takes place the nucleus stretches into the bud and is segmented off. These buds are the microgonidia or males, and may suffer segmentation like sperm mother-cells before being set free. The mother from which they budded is the macrogonidium, and is itself soon fertilized by a microgonidium, which is the child of another macrogonidium. *c* shows the first step in this conjugation. The nucleus, both in the macro- and the micro-individual, segments up into bits, smaller and smaller, and the microgonidium being absorbed, its microsomata are added to the more numerous microsomata of the female. Then there is gradual fusion until the single nucleus is reconstituted. Before this happens there may be division and budding, as in *a* and *b*. An exactly similar series of phenomena is described for *Epistylis plicatilis*.

FIG. 128, *a–e*. Conjugation of *Paramœcium*—Enc. Brit., "Protozoa."—This illustrates "temporary conjugation." *a* is a normal individual; *b*, two united for sexual ends. The nucleus and paranucleus divide successively, the former into many, the latter into four bits, and then they fuse again, only partially completed in *e*; but now the old nucleus becomes the new paranucleus, and the former paranucleus takes on the functions of the nucleus. The individuals separate and continue asexual division. This is probably an incomplete account of what happens. There is much controversy about this ill-understood process, but we must assume that there is mutual interchange of microsomata between the two individuals in harmony with some observations, and thus bring this process into line with what we know happens in all other cases of fertilization. (See text for further discussion.)

FIG. 129. Fertilization of egg of Bat—Van Beneden and Julin, A. B., i.—The two pronuclei are seen each in a vesicle lying in a clear space in the vitellus and in proximity to each other.

FIG. 130, *a–g*. Fertilization of ovum of *Sphærechinus brevispinosus*—Flemming, A. m. A., xx.—In *a* we see a large female pronucleus, and a smaller male pronucleus in the egg. In *b* each has been crowned by an aster. The male pronucleus now moves towards and fuses with the female pronucleus (*c*). The chromatin of the male pronucleus may split as in *d*, but soon all the chromatin of the fertilized nucleus is transformed into a segmented "skein" (*e*). At the same time polar asters appear, whose rays drive the segments to the equator (*f*), where they arrange themselves in a regular plate, split, and pass to the poles, there constituting the daughter-nuclei, one of which is shown at *g*, still crowned by its aster.

FIG. 131, *a–b*. "Genetic blending" of *Dallingeria drysdali*—J. R. M. S., April, 1886.—We may suppose the form with one flagellum, large nucleus, and granular zone to be female; then the form with three flagella and small nucleus is male. Both nuclei and bodies fuse to one individual, and then the nucleus is dissolved, and the cell is encysted, finally to burst, as myriads of spores, scarce visible under fifteen thousand diameters magnification.

FIG. 132, *a–d*. Fertilization phenomena in *Orchis latifolia*—Strasburger, Befruchtungs Vorgang bei den Phanerogamen, Jena, 1884; see also Jen. Zeits., xi.—Two sorts of nuclei, "germinative" and "vegetative," are found in the pollen-grain and tube, and these may multiply by karyokinesis. The former alone act as male pronuclei, and where there is more than one, the first one to make its way to the egg does the fertilizing; the others then are passive. The nucleus of the embryo-sac dividing sends each daughter-nucleus to its own pole, and there each undergoes division twice, producing four nuclei at each end of the sac. Then one of these from each end meet and conjugate in the centre (*z*) to form the mother-cell of the endosperm. Two of the remaining ones at the upper end (where the pollen tube enters) form the "synergids" (*s*) supposed to function in secreting a fluid attractive to the pollen-tube; the fourth becomes the ovum or female pronucleus (*y*). The three nuclei at the other end (s') are the antipodal cells. In *a* the male pronucleus has entered the ovum. In *b* the two have fused, but the nucleoli are still separate. In *c* the nucleoli are one; and in *d* the first segmentation spindle of the embryo is formed.

FIG. 133. A segmentation spindle from the egg of *Aulostomum gulo*—Nussbaum, A. m. A., xxvi.—To show the direct continuity of spindle-fibres with the yelk reticulum.

(*d*) FERTILIZATION.

FERTILIZATION, fecundation, copulation, conjugation, zygosis, are some of the terms used indiscriminately when referring to the fusion of sexual elements. We may refer to the *fusion* of nuclei, or of cells; or simply to the *apposition* of cells, or of individuals for sexual purposes. We shall use the term *conjugation* always in the former sense and *copulation* always in the latter. Thus we shall use the term *copulation* where other writers say "temporary conjugation." Conjugation of cells when not followed by conjugation of the nuclei produces *plasmodia;* we might use the term *zygosis* when fusion of the nuclei is involved. *Polyspermy* is where more than one male cell fuses with a female cell; and *superfecundation* implies, or should imply, the conjugation of more than two nuclei to form one *zygote.* We need one term more, and that is where, in polyspermy, the female nucleus segments by stenosis to furnish a partner for each of the male nuclei. For this case we would suggest the term *multifecundation.*

The modern theory of fertilization dates from the birth of the cell theory, when Kölliker extended its scope by advancing the view that the spermatozoon is a cell, and that it fertilizes the egg by a fusion with its substance, as against the theory that it was the fluid portion of the semen which holds the impregnating power. This view was not established until 1847, although Barry had seen the spermatozoon penetrate the ovum in 1843. It was now possible to compare fertilization with the conjugation which successive years of study continued to discover in the different groups of plants and animals, but with this line of development we are not here concerned.

In 1827, Baer described as *maturation* of the ovum the changes which the egg nucleus suffers, and Purkinje three years later named this nucleus the *germinal vesicle*, because it bursts and lets out its "generating lymph" through the germ. Attention was first called to the polar globules by Dumortier, and Müller named them *direction corpuscles* in 1848, because he thought they fixed the plane of cleavage. It was in 1862 that Robin gave them the name they now usually bear.

In 1842, Bischoff saw the germinal vesicle expelled from the egg during maturation, and this was confirmed by other observers, and thus the idea that the polar globules were the extruded germinal vesicle was gradually established.

In 1853, Keber discovered the micropyle, and the theory o actual penetration of spermatozoa into the egg thus received more favor, speculations concerning the functions of the spermatozoon became more numerous. Bischoff held the katalytic theory, by which molecular motion was supposed imparted to the egg through the spermatozoon. Meissner thought it was a nutriment, others thought it served to help maturation, and thus for a long time the formation of polar globules was supposed to depend on fertilization. The independence of these phenomena was shown in 1875 by Hertwig.

The penetration of more than one spermatozoon was seen by several observers, and it was only gradually that the idea gained ground that normally but one spermatozoon enters the egg. Perez thought, in 1879, that there may be degrees of parthenogenesis, so that if this is strong in tendency, it does not take as many spermatozoa to saturate the ovum as if weak.

The next step was the discovery of the sexual pronuclei. The male pronucleus (so termed by Fol) was first seen by Weil in 1873, but its direct morphological connection with the head of a spermatozoon was first established by Hertwig in 1875. Hertwig also showed that the whole germinal vesicle was not extruded in the polar globules, but that the germinal dot remained to be transformed into the female pronucleus, which fused with the male pronucleus. Auerbach had seen these pronuclei fuse, but supposed they originated in opposite poles of the egg, and by uniting, the characters of the different hemispheres of the egg would be mixed. Beneden and Bütschli practically saw the same thing later, but likewise derived these bodies by endogenous formation. Fol was, however, successful in seeing the female pronucleus derived from the amphiaster which extruded the polar globule; but it remained for Hertwig, in 1877, to show that the polar bodies arise by a true karyokinetic division of the egg-nucleus, and are thus the homologues of the female pronucleus. Bütschli and Giard arrived at this result independently.

Then Whitmann was enabled to give what we consider as the true theory of the polar globules,—viz., that they represent an asexual generation of cells that once were functional.[1] Beneden, Minot, and Balfour carried this view so far as to say that the polar globules are male cells. Thus, that every cell is hermaphrodite, having male and female plasmas, and that the cells become sexed by extruding one of these plasmas. It can then no longer develop until it has fused with a cell containing plasma opposite in character to itself. The absence of polar globules in any instance does not disprove the theory, for this plasm may be gotten rid of in many different ways. But this theory has lately received its death-blow by the discovery of polar globules in parthenogenetic ova. Strasburger has modified the theory by his idea that the nucleo-hyaloplasm is primary idioplasm, while the cytohyaloplasm is secondary; the former is conservative, the latter is adaptive. Cell phenomena are due to a dynamic interaction of the two. Two nuclei may be alike, but because the cytoplasms differ the cells will develop in a different manner. Cells become sexually mature, therefore, by getting rid, by division or any other way, of certain constituents in the cytoplasm.[2] Weismann says that these constituents are histogenic plasm,—*i.e.*, plasm which belongs to the cell as a cell,—and when this is lost then the plasm, which represents the generation of tissue-cells to come from the segmenting egg, may develop. A view similar in some respects was advocated by Robin in 1875.

It is strange how many different bodies, having not the slightest homology, have been appealed to to prove the sexual nature of protoplasm. Every sort of paranucleus has been worked into line with this theory. We have already adverted to the fact that paranuclei are themselves very different bodies. Thus, in Fig. 49, Gaule's paranucleus can be homologous only with the germinal dot of the (parthenogenetic) ovum; for from it the new cell develops, while the old nucleus goes to the ground. Besides paranuclei other things have been supposed to represent the lost sexed protoplasm, such as canal-cells, perivitelline excretions,

[1] Bütschli said the polar globules are to be considered as the first stages of development due to fecundation, rather than due to maturation.

[2] The idea of Fol is that certain substances injurious to further development must be excreted. This is only a general statement of the fact that cells must accomplish a certain cycle of work before they are sexually mature, most commonly a certain number of divisions.

synergid-cells, follicle-cells, nutritive cells, seminal granules, "remains" ("Rest") of protoplasm in spore formations, and, in fact, any sort of excretion and secretion. Trouble arises in explaining cases where more than one of these modes coexist. Thus, Sabatier holds that in gametogenesis one cell buds off a number of cells, which become nutritive to the mother-cell, in the ovary; while in the testes the daughter-cells develop to spermatozoa at the expense of the mother-cell. Such a theory as this cannot possibly be universally applied, and does not explain polar globules. Our knowledge of sex has developed by two steps more. Beneden showed in ascaris that the two pronuclei are just alike, each containing two loops that are placed in order in one equatorial plate in the zygote, and split as in ordinary karyokinesis, to furnish the two daughter-nuclei. (See Fig. 124, *l–o*.) In the latter the four loops reappear as a result of the process of reconstruction, so that Beneden thought that each daughter-nucleus had still two male and two female loops; and thus every cell of the body may be considered hermaphrodite, having the chromatins of the two sexes in morphologically distinct structures; and finally, when any cell becomes sexually mature, all that happens is a cell-division at right angles to the ordinary cell-division, thus separating the male from the female chromatin. But this theory is very faulty, for in the first place the phenomena of karyokinesis have as one object the mixture of the chromatins, and we know that this is accomplished in one phase or other somewhere between two successive divisions. Then, secondly, the chromatin derived from the spermatozoon possesses the characters of its ancestry, both male and female; if this be lost the characters which fertilization has bestowed are lost; and as this loss occurs with every generation, how could there ever be an accumulation of characters?[1] Only through the idea that chromatin is sexed can such grave errors as this arise. Platner (see Fig. 126) furnished an important contribution when he showed that in Arion the number of microsomata derived from the male pronucleus is less than a fourth as great as that of the microsomata in the female pronucleus. Thus the two pronuclei bear the relation of

[1] Strasburger holds that the contributions of the ancestors in each fertilization remain distinct in different parts of the mitom. Roux, in a somewhat analogous way, thinks that each portion of the egg-plasm corresponds with a definite portion of the soma that develops from the egg.

macrogonidia and microgonidia to each other. In Limax the microsomata are approximately equal in number in the two pronuclei; and as the result, so far as fertilization is concerned, is the same in the two animals, we must believe that the pronuclei need not be morphologically equal. It has been said that the two parents furnish equal contributions of hereditary characters because the chromatin is alike in amount in the two pronuclei. But this assumes that quality depends on quantity. We cannot accept this notion. We believe the quality of the chromatin inheres in the nature of each gemmule, that the gemmules are nearly alike, and that the quantity of chromatin may readily be increased by the multiplication of the gemmules. Such multiplication may take place in the male pronucleus before fusion because of the nutritive conditions furnished by the yelk. Even if it did not increase in this way, it might happen that the reproductive vigor of the fertilizing gemmules is so great that during ontogeny they would at last outnumber the ovum gemmules. We do not know whether characters are realized in proportion to the number of the gemmules, or whether it depends on the strength of the gemmules, or, again, on some dynamic influence reciprocally acting between the gemmules. In the last supposition we might have each gemmule possessing a system of vibrations whose wave-form could be slightly altered by the proximity of differing systems; and that, finally, equilibrium being established, it would require a new fertilization to introduce a new variation. It would also be intelligible how gametes may develop parthenogenetically before fusion is accomplished where only the preliminary steps to such end have been taken. Finally, such variation could be effected by other means than by fertilization.

Under the first supposition we could understand how, if cell-division should not succeed in separating the gemmules in due proportions, we might get cells that had a preponderance of gemmules of one ancestor, and the parts of the body developed from the offspring of these cells would present the characters of one parent to the exclusion of the other. But we defer the discussion of this point to the subject of heredity.

Strasburger claims that fertilization is effected by the fusion of similar parts in two cells, cytoplasm with cytoplasm, nucleus with nucleus, and nucleolus with nucleolus. But in phanerogams it is only nuclei that migrate from the pollen-tube to fuse with the egg, and in many animals it is only the head of the spermatozoon that makes the male pronucleus, the greater part of the flagellum not even getting into the yelk, so that we are justified in believing that fertilization is essentially a phenomenon of the mixture of chromatins. We cannot speak even of the union of "half nuclei" to make a whole nucleus, nor say that the nuclei are morphologically alike, nor yet that they are the *complements of each other* in any way. That the sexual pronuclei are physiologically alike we may infer from the fact that the characters of both parents are equally well transmitted, and from the fact that we may get both male and female parthenogenesis, which latter statement receives its best support from the evidence afforded by polyspermy and by the behavior of unfertilized eggs. We know that, aside from differences in size or in locomotor organs and other secondary characters, gametæ may differ physiologically in this way: in one, which we usually call the male, or microgamete, there has been a greater number of cell-divisions than in the female gamete, but in the latter we may, by enforced parthenogenesis, secure just as many divisions, and so make the cells alike. But neither of the gametes have divided as many times as they can, for it is possible, though more difficult than with the ovum, to get male parthenogenesis. The offspring thus resulting are more sexed, have greater desire as well as need for fusion with other cells, especially cells that have not divided as much as themselves. Unless we give such cells easy conditions of life we reach a stage when they can no longer divide. Such facts as these, observed with spores and the proto-organisms, enable us to understand certain phenomena obtaining with fertilization in higher forms of life.

We should expect that in most cases the ovum would possess a tendency to segmentation, which is realized normally under conditions of easy nutrition in parthenogenetic development, but may be realized in a less degree with other eggs. As a matter of fact there have been a number of observations in widely different groups of animals that show a sort of irregular segmentation of unfertilized eggs. I have observed such cases not infrequently. Such segmentation is slow and irregular, and probably cannot proceed as far as normal segmentation. Von Jhering saw the female pronucleus form an amphiaster in unfertilized eggs. Schneider, Greeff, Oellacher, and others have reported development in unfertilized eggs. But this phenomenon has not received the attention it deserves.

In polyspermy we find that not only does the female nucleus form an amphiaster, either alone or by zygosis, with one male nucleus, but that the male nuclei left unconjugated also form amphiasters. This phenomenon was first studied by Fol, 1879, but Hertwig has just published an article fully illustrating these forms. If more than one spermatozoon conjugates with the female nucleus it develops a tetraster (sometimes a triaster), or a figure having a greater number of poles according to the number of spermatozoa fusing. It results that segmentation follows a series whose terms are multiples of the normal one. But this only when there are no free spermatozoa in the yelk, for in such a case each of these also segments and receives its bud of cytoplasm, thus making the segmentation of the egg irregular. When the nuclei fuse before the spindle is formed, the number of spindles seems to depend on the number of nuclei. (This may be doubtful, as the poles seem to be determined by asters independently arising in the yelk, which migrate to the nuclei and direct their transformation.) But the amphiasters and the more complex tetrasters, etc., may also unite among themselves, regardless of sex, by superposition of poles, thus building up complex figures that may be as regular as a dodecahedron. The result is the fusion of daughter-nuclei of diverse origins. It follows, therefore, *that the spermatic nuclei after one segmentation have an affinity for each other.* Hertwig found further, that the nuclei resulting from the segmentation of pronuclei became fused again, but whether there was subsequent division and normal development remains an obscure question. The male nuclei also form triasters and tetrasters which cannot be distinguished from those made by the female pronucleus; but it is possible that in these cases multifecundation has taken place. Besides Fol and Hertwig, polyspermy has been studied by Bergh and Horst, 1881, and by Strasburger in phanerogams; Salenka and Schneider report normal development as following polyspermy; but this subject also requires further study.

Another line of study has been followed by Hertwig. It is well known that certain nuclei which are not too closely nor too distantly related to each other are prepotent in zygosis above these others, and that the egg resists the entrance of foreign spermatozoa. By letting the eggs lie a long time in impure water Hertwig has so weakened this resistance as to effect hybridization between forms not ordinarily capable of being thus hybridized. But as he got results closely similar with unfertilized eggs and also with eggs where polyspermy of its own species took place, and furthermore, that polyspermy ensued in these cases of enforced hybridization, we must be cautious in our inferences. To leave eggs a long time unfertilized, instead of developing the tendency to fuse with any partner, ought rather to develop the opposite or parthenogenetic tendency. Strasburger thinks superfecundation arises when the gametes are not sexually mature. But here again we have no thorough knowledge of the facts. Spermatozoa have also been seen to penetrate the polar globules, which is not remarkable, as we know that these are (when the first globule has divided again) the counterparts of the female pronucleus; but Hertwig found that the spermatozoa penetrate any globule of extruded yelk (whether it has a nucleus or not) when artificially pressed out through a rift in the egg membrane. Probably, then, the attraction of the spermatozoa is for the nutriment, or for the cytoplasm, and the nuclear attraction arises later in accordance with other laws.

We see from this survey that sex in its primary sense, as inhering in the nucleus, or perhaps in Strasburger's sense as due to a peculiar stimulus of the cytoplasm upon the unsexed nucleus, sex is not an absolute condition but admits of degrees, is, in fact, a want, a hunger, which the cells may experience in different degrees. How the mixture of different characters confers vigor to cell-division we cannot explain. Perhaps we would be more general if we said that fertilization consists in broadening cell-education. Hence parasites that are cells of one idea do not need it to any extent. At present we cannot see how it is possible to explain it on physical principles. It is, however, only a confession of ignorance to refer the problem of heredity to the domain of psychology; we have explained nothing in so doing.

The Protozoa.—Here the phenomena of fertilization are very varied. In the lower flagellates more than two cells may fuse; and polyzygosis has been observed also in Actinophrys and Arcella. We must, with Lankester, also place in this category the formation of plasmodia and of the *syzygies* of Sporozoa. In these plasmodia, especially when encystment occurs, there may be a fusion of nuclei to a greater or a less extent before spore multiplication; and the same thing happens with multinucleated forms like Gastrostyla, Actinophrys, and Actinospherium. Multinucleated cells are not separated from plasmodia by any distinct line, for in Heliozoa, Greeff found that division of the cell is facultative and optional, following the nuclear division, and if it occurs, the cell-bodies are apt to fuse again. In low forms of Protozoa conjugation also is as facultative as with those protophyta, where both male and female parthenogenesis have been noticed.

We may get conjugation between ordinary zooids, or one of the gametes may be a microgonidium while the other, not having divided so fast, remains as a macrogonidium. Again, the gametes may be due to spore formation; and here, again, the spores may be alike or unlike, and conjugation may be between like spores, or may be between macrospores and microspores. If the conditions of life are equal, the more often the cell-division has taken place the stronger is the desire and need of conjugation, so that where macrospores are parthenogenetic, microspores may be gametes. That this need of conjugation does not depend on the small quantity of idioplasm present may be gathered from two facts: first, when spore formation succeeds conjugation the resulting spores are smaller and more numerous than if parthenogenetically produced, but whereas the latter are apt to be gametes the former grow with vigor and multiply rapidly; secondly, where cell-multiplication allows time for the cell to grow as in ordinary gonidia, gametes are just as apt to form. In spore formation the microspores are not gametes more often than the macrospores because they are small, but because they have undergone division more frequently. In forms where both gonidial and sporular gametes occur, a failure to conjugate in the gonidial stage insures conjugation of the spores, while the occurrence of conjugation in the gonidial stage insures sporular parthenogenesis.

The Vorticellæ enable us to understand that fertilization has to do with quality of the gemmules and not with the number of these present. Two zooids which have resulted from the repeated division of a mother-zygote and standing near each other bend together and conjugate. But others just like these bud off a piece off the nucleus with some of the cytoplasm, and this goes swimming away until it finds the appropriate gamete (a macrogonidium) with which to fuse. As the chance of cross-fertilization is greater in proportion to the number of these microgonidia, they have acquired the habit of dividing a few times after their separation from the macrogonidium before starting out on their search for partners. Here, as with Arion, a small quantity only of the idioplasm is needed to effect fertilization. We do not contend that there may not be some advantage in starting with a large quantity of idioplasm, but we do call attention to the fact that, compared with the vigor due to the mixture of idioplasms of diverse experience, such advantage becomes quite secondary.

We may now pass to the consideration of the phenomena of copulation. The simplest cases join easily on to the case last considered. When the bud from the nucleus is not carried away by cell-division it may still be transferred to the interior of another cell, if such cell be brought with an aperture close to a corresponding aperture of its own cell. When the nuclear bud is produced at the time of the fertilization, Engelmann terms the gametæ "periodic hermaphrodites" (so far as this implies sex it is a misleading term). When, however, the nuclear bud remains as a permanent endoplastule and does not conjugate with the endoplast, except perhaps for a brief period in connection with fertilization, after which it is immediately budded off again to form the endoplastule, then Engelmann calls such a cell a "permanent hermaphrodite." In some cases the whole reproductive function may have passed over to the endoplastule, so that this never conjugates with the endoplast, but rather by its own division builds up the latter when this disintegrates. Periodic hermaphrodites are Stentor, Spirostoma, and Trachelius; while permanent hermaphrodites are Stylonychia, Euplotes, and Paramœcium.

Copulation is most frequent with the Ciliata, but has been observed in Peridinium and in one-chambered Rhizopods. An alternation of copulation with conjugation occurs in Stylonychia and in Platoum (Troglodytes). See Gabriel.

In connection with conjugation and copulation there is in all the higher forms a segmentation of the nucleus, or of the endoplast and endoplastule respectively. The last leads in the division, but is not divided up so finely as the endoplast. The phenomena are closely similar to those that accompany division. The cycle of segmentation and of fusion is passed through, so that the foreign idioplasm becomes incorporated into the nuclear structure. Possibly it does not get thoroughly mixed with the nuclear idioplasm in a molecular or rather gemmular intimacy, but as this process of segmentation and fusion is repeated for each division, there is no reason to suppose that after a while this may not be attained. Thus it is that *every cell-division is a fertilization.*

In the conjugation of Stylonychia, there is a fusion of nuclei with nuclei across the body, first uniting the nuclei of the two gametes; and then the anterior nucleus (zygote) fuses with the posterior one, after which the two nuclei are reconstituted. Possibly, Engelmann says, the nucleoli (endoplastules) do likewise. In copulation of Stylonychia there is segmentation of the nuclei and probably of the nucleoli, but Engelmann was unable to observe any transfer of material between the gametes. The nuclear fragments fuse to one body and bud off the nucleoli, but here there is disagreement, for in another case it seemed as if the nuclear products were extruded (Bütschli), the nucleoli became four in number, one disappeared, two became the new nucleoli, and the fourth, dividing, formed the endoplasts.

In copulation of Anoplophrya, Schneider could not observe any exchange of nucleoli, but the nuclei sent processes into the apposed cell, which became budded off mutually and fused with the remnant of the original nucleus to form a new nucleus, while the nucleolus came from one of the four segments into which the nucleolus divided; the other three disappeared. In Paramæcium, the endoplastule and the endoplast get segmented, the former usually into four, the latter into many, granules. Then there is a fusion of the fragments, but as to how this is done, and as to whether there is any mutual interchange of idioplasm, is a question which has received a dozen different answers.

Greeff thought the nucleolus was a semen capsule and the nucleus an ovary. The "eggs" that came from the "ovary" being fertilized, developed to living embryos viviparously. Stein called that part of the nucleus which remained after budding off eggs the "placenta," Balbiani, that the eggs were laid, and Engelmann also, with many other early observers, held views of a similar nature, according to which we had here a true hermaphodite. Engelmann subsequently modified his views to some extent, but Bütschli attempted to bring the phenomena into line with his observations on tissue-cells, and so he held that the nucleus is extruded, due to fertilization, and a new nucleus arises endogenously, and this is *rejuvenescence.* In 1882, Balbiani showed that there was an interchange of nucleoli; and Jickeli, in 1884, saw two nucleoli in the act of passing each other across the line separating the gametes. Lankester could find no interchange, but said that a portion of the segments of both bodies are lost, the remaining ones fuse to constitute the new nucleus and nucleolus, but *with reversed functions.* (See Fig. 128.)

Maupas, in 1886, said all the products of the nucleolus are lost except one; this divides, and one daughter remains and one crosses to the other gamete to fuse with the stay-at-home over there. The resulting zygotes segment to eight daughters; of these, three are absorbed, four become nuclei, and the eighth, after repeated divisions accompanying cell-division, becomes four nucleoli. The old nucleus is absorbed. Plate, in the same year, saw no interchange, but did see two nucleoli in apposition with a wall between. Gruber, however, saw the same thing, but no wall between, so that there was a chance for some interchange of substance. There was no fusion, however, for the nucleo-gametes separated and returned to divide into four. Gruber thinks the "stay-at-home" nucleolus acted in a similar way, for eight nucleoli result, and four of these fuse to form a new nucleus, the other four fuse to make a new nucleolus.

Truly, when such eminent observers disagree, who can decide? For our present purposes it is sufficient to know that there is an interchange in this case as in all others of fertilizing material, and that this is mutual and reciprocal. We cannot here, as did the older observers, speak of male and female idioplasm. That the functions of the endoplast are different from those of the endoplastule is evident, but Weismann claims that the reproductive plasma is restricted to the latter, while the former has only histogenic plasm. Thus, from a survey of fertilization in its relation to the nuclear phenomena, have we been enabled to get pretty clear notions of the significance of sex. But our morphological inquiry would not be complete did we not study the various methods of cell reproduction and observe the relations of these to the production of gametes. Several of the laws discoverable through such a survey have already been anticipated, but others will appear that are needful to the proper comprehension of the significance of sex.

Briefly, then, in conclusion, we have shown that the phenomena of life are the manifestation of forces that are organized, by being in some way connected with an ultimate unit, which unit, by multiplying and differentiating, forms units of a higher order; and these units repeat the same process, and so we get higher and higher units capable of a more complex life. Only in this way is organic life connected with inorganic life. A series of discrete degrees separates such life, as we study with the lens, from the substances with which the chemist deals. We can study the higher stadia morphologically, and only by analogy do we guess concerning the nature of the lower. We find the cell a reticulum of hyaloplasm holding microsomata in its nodes as nuclei. We find the soma of a metazoon likewise a reticulum in which the cell is the unit. As in the body, all cells come from embryonic or germinal cells, all traceable back to a single egg, so in the cell, all the differentiated gemmules, or micellæ, or tagmata[1] are descended from nuclear idioplasm, which is itself due to the multiplication of a single gemmule. Finally, we find that cell phenomena are accompanied by fusion or mixture of idioplasms that have had diverse experiences, and in some way the cell-life is thereby invigorated. Sex has been evolved as the means of effecting such fusions. The distinction of male and female has arisen comparatively late and is coupled with very secondary characters.

We have seen that half a dozen different structures are present in the cell, and that those in the spermatozoon are transformed into the different parts of its structure. Undoubtedly in the metamorphosis of all tissue-cells these structures play a part. If we could see which of these structures preponderates in a given tissue or organ, we could infer that the function of this part is similar in the cell to the function of the tissue in the soma.

Gaule's work on the cytozoan, or paranucleus, which can wander from cell to cell, and on which the cell-life depends, is yet too little known to be criticised. We may expect fuller details when Gaule has completed his researches.

[1] The ferments such as zymogen, etc., which are lower in the scale of organization than the bacteria, seem to come in somewhere near the plane occupied by the *gemmule;* but their relation to the latter is probably at present beyond the scope even of a guess.

LITERATURE BEARING ON THE SIGNIFICANCE OF THE CELL-NUCLEUS TO THE PROBLEM OF SEX.

The following are a few of the principal papers bearing on the subjects discussed in the preceding pages. The list does not include those referred to in the text, or in the explanations of the plates.

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NOTE.—The substance of what has been published under the head of Significance of Sex was originally delivered as part of a series of lectures in the spring of 1886, from random notes. In preparing the article for publication I have added historical matter and the latest literature, but the plates having been first prepared, do not contain, as they otherwise would, some of the instructive figures which accompanied this later literature.

JOHNS HOPKINS UNIVERSITY, March, 1887.

THE TACONIC QUESTION RESTATED.

BY T. STERRY HUNT.

(Continued from page 125.)

§ 15. WE have said above that Emmons, in his "Agriculture of New York," published in 1846, referred the upper portion of his Taconic to the horizon of the Calciferous Sand-rock. It is, however, important to note that in Chapter V., there devoted to the account of the "Taconic System," and previously printed separately in 1844, two years earlier, he still adhered to the opinion expressed in 1842, that the whole Taconic system was "inferior to the Potsdam sandstone," and repeated, in 1844, that "the Taconic system occupies a position inferior to the Champlain division of the New York system, or the lower division of the Silurian of Mr. Murchison." In support of this view he attempts, in 1844, to show that both the Potsdam sandstone and the Calciferous Sand-rock are found, the latter at intervals to the east of the valley of the Hudson, reposing upon the slates of the Taconic system, but adds, "probably, however, upon the Magnesian slates," which, as we have seen (§ 12), were assigned by him to a horizon below the group called by him distinctively the "Taconic slates," and were subsequently included in his Lower Taconic, the latter being Upper Taconic. In the same volume, in a subsequent chapter, which first appeared in 1846, or two years later, he had, however, arrived at the conclusion that the Calciferous Sand-rock to the eastward becomes more largely developed, and, losing the distinctive character which had given that name to the west of Lake Champlain, becomes, to use the expression of Emmons, "protean" in its modifications. Among these he now included the red sandstones of Addison, Charlotte, and Burlington, Vermont, with their interstratified red and chocolate-colored slates, besides blue limestones and gray calcareous sandstones, the whole resting upon what were designated as black Taconic slates. These so-called protean modifications of the Calciferous Sand-rock were now described by Emmons as forming an irregular belt from Canada through Eastern Vermont, thence traversing Washington, Rensselaer, Columbia, and Dutchess Counties, and crossing the Hudson into Orange County. This series, more or less interrupted in its geographical distribution, but including areas of some miles in extent, is described as "often forming the highest points in the region," and Emmons remarks, "We can hardly avoid the conclusion that this belt was once continuous, and formed an important mass overlying the Taconic slate."[1]

§ 16. It is scarcely necessary to remark that this great belt of sandstones, slates, and limestones, now described by Emmons, in 1846, as belonging to the Calciferous Sand-rock, and as resting on Taconic slates from Canada to Orange County, N. Y., is no other than the First or Transition Graywacke which, with the

[1] Agriculture of New York, vol. i. pp. 118–122.

same geographical distribution and similar lithological characters, had long before been described by Eaton as resting unconformably upon the Transition Argillite (§ 2), and subsequently by Mather (§ 8) and (apparently) by Emmons (§ 10) had been referred to the horizon of the Second Graywacke. It will also be remembered that the Sparry Lime-rock, which we know forms an upper member of this Graywacke series, was already by Eaton, in 1832, regarded as the stratigraphical equivalent in the eastern region of what he had called the Calciferous Sand-rock to the west of Lake Champlain. Emmons had thus in 1846, after his previous statements printed in 1842 and 1844, arrived to the same conclusion as his old master, and now assigned the great mass of uncrystalline more or less fossiliferous strata, which he subsequently called Upper Taconic, to a horizon below the Trenton limestone, and regarded it as the equivalent of the Calciferous Sand-rock, including, however, as he afterwards taught, also the representative of the Potsdam sandstone. When he speaks of this great Graywacke group as resting on Taconic slates, we must remember that already in his first recognition of the superposition of Calciferous Sand-rock to Taconic slates in 1844, as above cited, he had declared these to be "probably the Magnesian slates," which correspond to the Transition Argillite of Eaton, included in the Lower Taconic, and not to what he elsewhere designates as the proper "Taconic Slate" group, which was later included in his Upper Taconic, and is no other than this same "protean" Calciferous Sand-rock and Potsdam sandstone, or the First Graywacke itself.

§ 17. Emmons could scarcely have defined more clearly than he did in 1844[1] the great extent and the boundaries of this Taconic slate group as then known to him, with its breadth of fifteen or twenty miles, occupying the greater part of the three counties named in Eastern New York, and stretching from north to south one hundred and fifty or two hundred miles; its limitations on the west by the overlapping upper members of the Champlain division, and on the east by the great mass of the Sparry limestone, portions of which are said to occur at intervals in the section farther westward. He, moreover, declares in 1844,

[1] Agriculture of New York, i. 65–72. We quote from this volume for the reason that it is more generally accessible than the first and separately printed edition of the monograph.

that in this Taconic slate group—described in 1842 as "often becoming a coarse graywacke" and now called "protean"—are numerous subordinate divisions, among which he mentions coarse greenish sandstones, gray sandstones, red and chocolate-colored shales, roofing-slates, green and black flinty slates, blue compact limestones, and gray silicious limestones, all of which are included in this great disturbed and faulted belt of uncrystalline strata. One of these subdivisions he described as a black slate with trilobites, and noticed another containing impressions resembling graptolites. In further proof of the fossiliferous character of this great Taconic slate group, which he had already, in 1842, referred to "the lower part of the Silurian system," he declared that besides these in the black slates just mentioned he had found fossils in the green sandstones and the green slates; while with regard to the Sparry limestones he remarks that "no fossils have yet been discovered in this rock, though it must be confessed sufficient examination has not yet been made for microscopic bivalves."

§ 18. It is here important to remark that the term "Taconic slate" applied to this upper and notably fossiliferous portion of the Taconic system of Emmons has led to the erroneous opinion that it is in some special sense the representative of the system, and to look upon the lower members as of less significance; a view which, it is unnecessary to say, finds no countenance in the publications of Emmons. Eaton, as we have seen, asserted the existence of a stratigraphical break between the Taconic slate, his First Graywacke, and the underlying Transition Argillite. This upper unconformable portion was afterwards separated by Emmons from the inferior members of the system, and designated Upper Taconic. In his "American Geology," in 1855, he in fact proposed to consider the Taconic system as consisting of two parts, between which, according to him, "the line of demarcation is tolerably well defined." Of these, the lower part, henceforth called by him Lower Taconic, included (1) the Primitive Quartz-rock, (2) the Primitive Lime-rock, or Stockbridge limestone, and (3) the Transition Argillite, or Magnesian slate, with the lower roofing-slates. The Upper Taconic included the great group of the First Graywacke, called by Emmons, in 1842 and 1844, the Taconic slates, with the Sparry Lime-rock, called by him the Sparry limestone. This same view is again set forth by Emmons, in his "Manual of Geology" in 1860, and in his subsequent reports on the geology of North Carolina.

§ 19. It is important to note that the line of demarcation between the Lower and Upper Taconic series corresponds to the stratigraphical break already pointed out, in 1832, by Eaton between the Transition Argillite and the First Graywacke. It should be further mentioned that this division is one between a series of essentially crystalline strata below and one of earthy sediments above; and, moreover, that the facts known with regard to the distribution of the two show clearly that their areas are not co-extensive. While found superimposed upon the Lower Taconic in certain districts, the Upper Taconic is wanting over great areas of the Lower, and is elsewhere seen in many places resting unconformably upon pre-Taconian crystalline schists.

It was this Upper Taconic which Emmons, in 1842, declared to belong to "the lower part of the Silurian system," which he showed, in 1844, to contain organic remains, such as trilobites and graptolites, in several of its subdivisions of shales and sandstones, remarking that while they had not yet been found in the Sparry Lime-rock sufficient search had not been made therein. It was the same Upper Taconic or Taconic slate group which he later, in 1860, declared to correspond to the Primordial zone of Barrande, which latter was included alike by Barrande and by the other followers of Murchison, both in Europe and America, in the so-called Silurian system. Yet, notwithstanding all these facts, we find that the discovery in Eastern New York of fossils of Cambrian and Ordovician age in what J. D. Dana calls "a limestone of the original Taconic of Professor Emmons,—his Sparry Limestone,"—is brought forward in 1885 as an argument against the views of Emmons. In a letter to Marcou, dated Albany, September 1, 1860, Emmons writes, "The upper part of the Taconic is equivalent to Barrande's Primordial group," while in his "Manual of Geology," also published in 1860, he declares (p. 89) that "it has been shown that the Primordial zone in Bohemia is in co-ordination with the upper series of the Taconic rocks." In another letter to Marcou, in November of that year, he expressed the opinion that neither his Taconic system nor the Primordial zone or group of Barrande was Silurian, but in a subsequent letter, November 29, 1860, admits his misconception and writes, "On reading his [Barrande's] papers I found that, after all, his Primordial group is only Lower Silurian. I conceive that we have exactly his Primordial group in the band of slates containing the Paradoxides." (Olenellus.)[1]

§ 20. The study of these Upper Taconic rocks in the province of Quebec by the geological survey of Canada was carried on in the vicinity of the city of Quebec in 1852–1855, the present writer being at intervals an assistant to Logan in his field-work in that district. The official reports of Mather and Emmons on the geology of New York were then repeatedly consulted, and the Taconic system of the latter being then generally discredited, the passages in accordance with the views of Mather, which, as we have already noticed, are to be found on certain pages of that volume, were alone accepted, and the Graywacke series of Quebec and its vicinity was referred to the horizon of the Second Graywacke of Eaton. This great thickness of contorted shales and sandstones, with intercalated limestone and dolomite beds, already described, in 1827, by Bigsby as "a slaty series of shales and graywacke," was then called Hudson River group, and assigned to a position above the horizontal and well-characterized Utica and Trenton divisions found a very few miles away on the west side of the St. Lawrence, while the green sandstones which apparently overlie these inclined strata were designated Oneida sandstone. They were thus described and mapped in the "Esquisse Géologique du Canada," bearing the names of W. E. Logan and the present writer, but prepared by the latter, and published in Paris in 1855.

§ 21. The great belt of disturbed strata described, in 1827, by Bigsby as "a slaty series of shales and graywacke," which by the united labors of Eaton, Emmons, and Logan had now been traced with little interruption from the banks of the St. Lawrence below the city of Quebec, along the west side of Lake Champlain, and thence nearly to the Highlands of the Hudson, constituting the Upper Taconic of Emmons and the larger part of the Hudson River group of Vanuxem. That this, contrary to the teachings of Eaton, but in accordance with the views of Mather, was regarded as above, and not below, the horizon of the Trenton limestone appears, from James Hall's Report to the geological survey of Canada, published in 1857, on the grapto-

[1] Letter of Emmons to Marcou, November 20, 1860, in Marcou's "Taconic System."

lites of Pointe Levis, which were then described as belonging to a higher horizon than the Utica slate, and in the words of Hall, to "that part of the Hudson River group which is sometimes designated as Eaton's Sparry limestone,—being near the summit of the group." Still later, in 1859, with regard to the trilobitic strata of the town of Georgia, Vermont (the "slates with Paradoxides" of Emmons, noticed in § 19), Hall wrote, "I have the testimony of Sir William Logan that the shales of this locality are in the upper part of the Hudson River group, or form part of a series of strata which he is inclined to rank as a distinct group above the Hudson River proper."

§ 22. It was in 1856 that the finding by the present writer of an unknown trilobite in one of the many limestone bands of this Graywacke series at Pointe Levis, opposite the city of Quebec, led to further researches, revealing in that series a fauna which furnished to Billings convincing proof that the view of Eaton and Emmons was the correct one, and that this same Graywacke, or Hudson River group, was below and not above the horizon of the Trenton limestone, and was in fact the First and not the Second Graywacke of Eaton. This was first admitted by Logan in a letter to Barrande, dated December 31, 1860, but published in 1861.[1] In this, referring to the trilobitic beds in Vermont noticed above, which he had placed at the summit of the Hudson River group, but now declares that he had "recognized as equivalent to the magnesian part of the Quebec group," Logan writes, "Prof. Emmons has long maintained, on evidence that has been much disputed," that these rocks "are older than the Birdseye formation" (the basal beds of the Trenton), and adds, "the fossils which have this year been obtained at Quebec pretty clearly demonstrate that in this he is right."

Refusing, however, to adopt the name of Upper Taconic or that of the First Graywacke, Logan, for reasons of his own, chose to give to these rocks the title of the Quebec group, a name which he extended to the whole belt from the Lower St. Lawrence to the valley of the Hudson River, and henceforth made no further allusion to Emmons, whose views he had now adopted. In accordance with the teachings of Emmons in 1846 and 1855, these rocks were now declared by Logan to be a great development of sediments about the age of the Chazy and the

[1] American Journal of Science, xxxi. 220.

Calciferous divisions of the New York system. The Red Sand-rock included in this belt in Vermont was, however, subsequently, from its fauna, referred by Billings of the Canada geological survey to a lower horizon, the so-called Lower Potsdam, and an attempt was made to establish a Potsdam group beneath the Quebec group, including both the Red Sand-rock (which Logan, in 1859, had placed above the summit of the Hudson River group) and a group of strata at Farnham in Quebec, which are, however, of Chazy if not of Trenton age.

§ 23. The subsequent history of Logan's endeavor to separate the Graywacke series, as displayed near the city of Quebec, into what he called the Levis, Lauzon, and Sillery divisions of the Quebec group, and his conjecture that the apparent order of superposition in the section there exposed represents the real or true order has been elsewhere told in detail. By his adoption of this conjecture the Levis or Sparry Lime-rock was put at the base, and the massive green Sillery sandstone at the summit of a Graywacke series of many thousand feet, all of which was but a reaffirmation of the old hypothesis of 1855, which had made this sandstone the Oneida, and the underlying gray sandstones, with shales and limestones, the equivalent of the Loraine. That this apparent order was contrary to palæontological evidence was pointed out by Billings, who insisted that the horizon of the Sparry Lime-rock, and its adjacent Phyllograptus shales, was somewhat above the typical Calciferous Sand-rock of New York, and that the massive green sandstones belonged to a much lower horizon.

Logan, although he had borrowed from Emmons the conception that the great Graywacke series was really below the horizon of the Trenton limestone, still adhered to the stratigraphical scheme which he had framed when he believed that the section at Quebec and Pointe Levis represented the Loraine shale, with a great overlying mass of green sandstones with conglomerates and red shales, corresponding to the Oneida of the New York system. These sandstones, he now thought, might correspond to the St. Peter's sandstone of the Upper Mississippi, and to the sandstones and shales which in parts of the Ottawa basin appear in the Chazy subdivision. The history of all this has been set forth in the writer's volume on "Azoic Rocks, etc."[1] The dif-

[1] Second Geological Survey of Pennsylvania, Report E, 1878.

ferences between Billings and Logan on these points appear in the volume of the former on "Paleozoic Fossils,"[1] and more fully in the instructive correspondence of Billings with Jewett and Marcou, lately published by the latter in his paper on the Taconic system in 1885.[2]

§ 24. James Hall, who had in 1857 declared that the graptolitic slates found in conjunction with the Sparry Lime-rock at Pointe Levis, the Levis limestone of Logan, were at the summit of the Hudson River group,—employing this term, as he had always done, as synonymous with Loraine shales,—was led by the palæontological discoveries in Vermont, and near the city of Quebec, to reconsider the age of this so-called group and the true significance of the term. In his "Report on the Geology of Wisconsin" in 1862 (p. 443), he referred to the evidence furnished by organic remains in the rocks of the Graywacke belt in the province of Quebec and in Vermont, "which prove conclusively that these slates are to great extent of older date than the Trenton limestone," though probably newer than the Potsdam. He remarked, moreover, that "the occurrence of well-known forms of the second fauna . . . in intimate relation with, and in beds apparently constituting a part of, the series along the Hudson River, requires some explanation. Looking critically at the localities in the Hudson valley which yield these fossils, we find them of limited and almost insignificant extent. Some of them are on the summits of elevations which are synclinal axes, . . . where the remains of new formations would naturally occur. Others are apparently unconformable to the rocks below, or are entangled in the folds of the strata, . . . while the enormous thickness of beds exposed is almost destitute of fossils." He hence concluded that the name of Hudson River group cannot properly be extended to the great mass of strata which had hitherto borne that name, but which he now regarded as distinct from "the Hudson River group proper."

§ 25. Thus while still retaining for the Loraine shales the name under which Vanuxem had, in 1842, included alike these shales and the great underlying mass of older strata belonging to two lower horizons which constitute by far the larger portion of the

[1] Geological Survey of Canada, 1865; Paleozoic Fossils, vol. i. *passim*.

[2] Proc. Amer. Acad. Sciences, New Series, vol. xii. pp. 174–256. See also therein the letters of Emmons and Marcou, pp. 184–201.

rocks hitherto called Hudson River group, Hall admitted the distinctness and the greater antiquity of these. In 1877, while justifying the retention of the name of Hudson River group for the fossiliferous rocks of Loraine age found along the banks of that river, and originally called "Hudson slates" by Mather,—which Hall speaks of as "the newer series, or the rocks above the Trenton limestone," as contradistinguished from the older or infra-Trenton series,—he admits that "the error lay in extending the term [Hudson River group] to rocks on the eastward, at a time when their fossil contents had not been studied . . . and their geological position had not been determined by critical examination."[1]

The geological position of these rocks to the eastward and their relation to the newer series had, however, already been determined, and Hall, in 1862, did but repeat the statements long before made by Emmons, who, in 1842, had declared that the Taconic slate group was undoubtedly overlapped along its western border by "the Loraine or Hudson River slates." Again, in describing, in 1846, beds of the Loraine shale alternating with the sandstone of the Gray band in the valley of the Rondout, and in their northern outcrop along the termination of the Helderberg range, Emmons declares that this section of the Loraine strata "resembles the beds which occur in patches on the east side of the Hudson along the Western [Boston and Albany] Railway. These latter beds may be clearly distinguished from the slates and shales of the Taconic system. They neither conform with them in dip nor in strike," and, except in the immediate vicinity of the great northern fracture of the Hudson valley, their dip and their disturbance are not excessive. These unconformably overlying areas of Loraine shales resting on the older Graywacke were said to form a small range between Chatham Centre and Chatham Four Corners, "where they lie in deep troughs and are exposed in the railway cuttings." In some cases, we are told, "their peculiar distribution and the confined limits of the fossiliferous beds render quite difficult the recognition of these shales when they lie in proximity to the Taconic system."[2] It was thus clearly shown by Emmons, in 1844, that the Loraine shales not only overlie the Upper Taconic or First Graywacke along its

[1] Proc. Amer. Assoc. Adv. Science, 1877, p. 263.

[2] Emmons, Agriculture of New York, pp. 124, 125, 128.

western border in New York, but are found thereon in small unconformably overlying areas, as was admitted by Hall in 1862.

§ 26. These facts regarding the relation of the Loraine shales to the great Graywacke belt were set forth by the writer in 1878. It was at the same time shown that within the limits of this belt, in the province of Quebec and in Vermont, there were found organic forms ranging from a horizon at least as low as the Potsdam (the Olenellus or Lower Potsdam beds of Billings, which were the Paradoxides beds of Emmons) to the Phyllograptus shales (belonging to the horizon of the Arenig or Skiddaw of Great Britain), without counting the fossiliferous beds at Farnham, Quebec, assigned by Logan to the base of the Quebec group, but shown by Billings to be not lower than the Trenton. In other words, it was set forth that this First Graywacke, otherwise called the Taconic slate group, Upper Taconic and Quebec group, had been by Emmons, as long ago as 1842, declared to belong to the age of the Silurian of Murchison; that he had shown it in 1844 to contain in its various subdivisions trilobites, grapolites, and fucotids, and had in 1860 referred the same Taconic slate group to the Primordial zone, or so-called Primordial Silurian of Barrande. Still further, it was shown that it had been maintained by Emmons in 1844, and confirmed by Billings, that within this belt were accidentally included unconformable portions of post-Trenton fossiliferous strata of the Champlain division.

It was further pointed out by the writer in illustration of these facts that similar conditions appear in the basin of the Ottawa, near the city of that name, where, as the result of an unconformity between the upper and lower members of the Champlain division, a belt twenty miles long of shales and sandstones, carrying the fauna of the Utica and Loraine subdivisions, is found lying transgressively alike on the Trenton, Chazy, and Calciferous subdivisions, as long ago shown by Logan.

§ 27. The observations of Ford, Dwight, and Dale along the great Graywacke belt to the east of the Hudson, in the State of New York, which show, besides a Cambrian fauna of Potsdam and Calciferous age, the presence of small areas of strata belonging to the higher divisions of the Champlain divisions, are thus in direct confirmation of the original statements of Emmons, the later determinations of Billings, and my own teachings. They show the horizon of the Upper Taconic or Taconic slate group—the Transition or First Graywacke of Eaton—to be, as taught by Emmons in 1842, the lower part of the Silurian system, as he understood it, and as he later declared it to be, the Primordial zone or Primordial Silurian of Barrande. If, then, we except small areas of true Silurian (Lower Helderberg) and possibly Devonian strata, as at Becraft's Mountain, near Hudson, New York, and, according to James Hall (as cited by Edward Hitchcock), in Vermont, it will be seen that the great belt of Graywacke, stretching from the St. Lawrence to the Hudson River in Dutchess County, is of Cambrian age, with overlying and included patches of Ordovician (Chazy-Loraine) and a few small areas of Silurian.

It may here be added that the evident ignorance of these historical facts which is apparent therein, is the only excuse which can be pleaded for the misstatements which have of late years been repeatedly put forward with regard to this important problem in American geology.

§ 28. Marcou, who had already, in 1880, insisted thereon, declares in 1885, the "time has now come to make clear the prior right and the real advantage to be found in the use of the term 'Taconic System,' instead of the so generally employed expressions 'Cambrian' and 'Silurian,' to designate the strata enclosing the Primordial fauna.[1] In answer to this proposition, it is to be said that the names of Silurian and Cambrian were proposed for the great Transition or Graywacke series of Wales by Murchison and Sedgwick in 1835 and 1836. We need not here repeat the long history which I have elsewhere told,[2] of the means by which it was sought by Murchison to include in his Silurian the greater part of the Cambrian of Sedgwick, a task in which he was seconded by Barrande, who called the horizon of the lowest Cambrian fauna —his Primordial zone—Primordial Silurian.

In the great work of the New York geological survey, begun in 1837 and summed up in the final reports of 1842 and 1843, a succession was independently wrought out for the American palæozoic basin, in which were named the "New York System" and the "Taconic System." As regards the probable parallelism of these with the previously-named Cambrian and

[1] The Taconic System, Proc. American Academy of Sciences, 1885, xii. 244.

[2] Hunt, History of Cambrian and Silurian, Chemical and Geological Essays, pp. 349-425.

Silurian, we find Emmons, in 1842, suggesting that the Taconic rocks in part might "be equivalent to the Lower Cambrian of Sedgwick," "the upper portion being the lower part of the Silurian System," to which the Middle and Upper Cambrian of Sedgwick were then, on the authority of Murchison, very generally referred. To repeat what we have already said, we add that this upper portion, the fossiliferous character of which he made known in 1844, was by Emmons declared, in 1860, to correspond to the Primordial of Barrande. "The upper part of the Taconic is equivalent to Barrande's Primordial zone," and again, "His Primordial group is *only Lower Silurian.* I conceive that we have exactly his *Primordial group* in the band of slates containing *Paradoxides.*"[1]

The names of Cambrian and Silurian were thus prior to that of Taconic, and so far as regards the Upper Taconic, it is now shown by palæontological studies to be unquestionably the stratigraphical equivalent of the great mass of the Cambrian of Sedgwick, including accidentally, as we have seen, small portions of his Upper Cambrian (Ordovician), but excluding, so far as yet known, the lowest Cambrian or Paradoxides horizon. It remains to be seen whether American or European geologists will abandon the accepted and well-defined terms of Cambrian for that of Taconic.

(To be concluded.)

NOTES ON THE GLACIATION OF THE PACIFIC COAST.

BY G. FREDERICK WRIGHT.

I HAVE elsewhere (see *Am. Jour. Sci.* for January) given an account of the results of my observations during last summer on the Muir Glacier, Alaska. The journey to and from that point of interest afforded equally good opportunities for observation.

The Northern Pacific Railroad passes out of the glaciated region at Sims' Station, Dakota, about forty miles west of Bismarck, at an elevation of two thousand two hundred and eighteen feet

[1] The italics are as found in the printed text.

above tide and three hundred and fifty above the Missouri River. The passage from the glaciated to the unglaciated region is quite marked and can easily be detected from the train. From this point on to the west no signs of glaciation appear until passing the western ridge of the Rocky Mountains near Lake Pend Oreille in Idaho. Here the movement was towards the west and was evidently local. Water-worn pebbles from this vicinity were observed far down in Eastern Washington Territory, in old water-courses, or "coulees," worn by post-glacial streams in the extensive lava deposits of that region.

West of the Cascade Mountains, between Portland and Seattle, all the streams coming down from Mount Rainier and its companions are heavily charged with glacial mud, and can be traced to extensive glaciers in the mountains. The White River Glacier, on the north side, is the largest of these. This glacier is from one to one and a half miles wide at its termination, which is about five thousand feet above tide. Two or three miles farther up it is about four miles wide. It is about ten miles long, and in its higher level merges in the general ice-cap which envelops the upper five thousand feet of the mountain. The height of the mountain is fourteen thousand four hundred feet.

The north and south valley between the Cascade Mountains and the Coast Range in Washington Territory is about one hundred miles wide. The northern half of this is penetrated by the innumerable channels and inlets of Puget Sound, which extends from Port Townsend south about eighty miles to the parallel of Mount Rainier. The Olympian Mountains to the west rise to a height of about ten thousand feet, as does Mount Baker in the Cascade Range to the northeast. The shores and islands of Puget Sound have every appearance of being a true glacial accumulation. No rock in place anywhere appears. The shores and islands rise from fifty to two hundred feet above tide, and present a mixture of that stratified and unstratified material characteristic of the terminal accumulations of a great glacier. Boulders of light-colored granite and of volcanic rocks are indiscriminately scattered over the surface and embedded in the soil. One of these boulders near Seattle, two hundred feet above the sound, was twenty feet in diameter and twelve feet out of ground. The channels of the sound and of the adjacent fresh-water lakes have a general north and south direction, parallel with the axis of the valley. This is specially noticeable near Seattle, where Lake Washington, elevated sixteen feet above tide, and twenty-five miles long, is strictly parallel with the sound, and is separated from it by a series of ridges showing every mark of glacial origin. Not only is the surface of these ridges covered with boulders, but wherever the streets have cut down into the soil they show, at the depth of a few feet, an unstratified deposit abounding in striated stones. Superimposed upon this ridge there is a thin stratified deposit of varying depth but increasing in extent down the slope towards tide-water. At Port Townsend, on the Strait of Juan de Fuca, and forty miles north-northwest of Seattle, the coarsely stratified deposit is much greater in extent. A noteworthy section of this I had the privilege of studying at Point Wilson, two and a half miles northwest of Port Townsend. Here, facing the strait, is a perpendicular bluff from one hundred and fifty to two hundred feet in height, composed, in its lower portion, for about one hundred feet of rather fine, stratified material, which is capped at the summit by about fifty feet of coarse, unstratified material abounding in large striated boulders, which as they have been washed out by the erosion of the sea have fallen down to the foot of the bluff in immense numbers. Near the bottom of the bluff there are several strata of vegetable deposits. One of these, two feet thick, consisted almost wholly of the fragments of the bark of the fir-trees which are now so characteristic of that region. Fragments of wood project from the freshly exposed bank in great abundance. The meaning of these facts will be more readily apparent after a study of the phenomena to the north of the strait.

The Strait of Juan de Fuca is from fifteen to twenty miles in width, running east and west. Its north shore, near Victoria, on Vancouver's Island, is remarkably clear of glacial débris. The rocks, however, near Victoria exhibit some of the most remarkable effects of glacial scoring and striation anywhere to be found. Immediately south of Victoria long parallel furrows rise from the shore of the inlet and ascend the slope of the hill to the south to its summit, a hundred feet or more above the water-level. At the steamboat-landing, outside of the harbor, extensive surfaces freshly uncovered exhibit the *moutonnée* appearance of true glaciation, and, in addition to the finer and abundant scratching and striæ, display numerous winding furrows from six inches to two feet in depth, and from twenty to thirty-two inches in width, and ten or more feet in length. These grooves are finely polished and striated, resembling those with which geologists are familiar on Kelly's Island, Lake Erie. Like the corresponding grooves on Kelly's Island, some of these also turn around the southern point in graceful curves, adjusting themselves to the retreating face of the rock-wall. That the motion of the ice here was to the south is evident not only from the direction of the striæ, but from the fact that the stoss side of the glaciated rocky projections are towards the north. That they are due to glacial action, and not to icebergs, is evident both from their character and from their analogy to numerous facts farther to the north, which are unquestionably connected with true glaciers.

Vancouver's Island, which trends parallel with the shore of the continent, northwest by southeast, is nearly three hundred miles in length, and from fifty to seventy-five in breadth. In character it seems but a continuation of the Coast Range of mountains, with numerous peaks rising from four to seven thousand feet above the sea. The shore-line of the continent upon the northeastern side of the Strait of Georgia is formed by a continuation of the Cascade Range, with a general elevation of from three to eight thousand feet, penetrated in numerous places to a distance of seventy-five miles by inlets or fiords several miles in width. Mr. George Dawson has described the glacial phenomena in Bute Inlet, which enters the Strait of Georgia about opposite the centre of Vancouver's Island, in latitude 50° 30′. He describes the chasm (see *Quarterly Journal of Geolog. Soc.*, vol. xxxiv. p. 89) as forty miles in length, surrounded by mountains, rising in some places in cliffs and rocky slopes from six to eight thousand feet. "The islands about its mouth are *roches moutonnées*, polished and ground wherever the original surface has been preserved."

The mountains on either side the Strait of Georgia, and northwestward to the head of Lynn Channel, in latitude 59° 20′, are snow-clad throughout the whole season. The shores are everywhere rocky and precipitous, retaining in many places far up their sides glacial striæ parallel with the direction of the numerous channels which thread their way through the Alexander Archipelago. I had opportunity at Loring, on the western shore of Revilla Gigedo Island, to examine minutely the striation on the shores and islands of the bay. There are now no glaciers coming down from the mountains of this island, but the shores and islands abound in well-preserved glacial striæ running W. by 18° N., corresponding to the direction of the local valley down which the glacier came, and entering Behm's Canal nearly at right angles to its course upon that side of the island. This is in latitude 55° 40′.

Upon proceeding one degree to the north, I had opportunity also to observe closely the striæ at Fort Wrangell. Here, too, they show the influence of the continental elevation to the east, and are moving outward in a westerly direction towards the Duke of Clarence Strait. About thirty-five miles up the Stikine River, two glaciers are encountered of immense size coming down, one from the north and one from the south, to the vicinity of the vast cañon through which the river runs. The glacier from the north is about forty miles long and two miles wide near its mouth, spreading out to five miles a short distance back from the river, which it approaches to within four hundred yards. The glacier approaching the river at this point from the south is not so long and reaches only to within about two miles of the river. It is clear that a comparatively slight extension of these two glaciers would make them unite and close up the outlet of the river, and it requires no great stretch of the scientific imagination to see the whole valley occupied by a glacier, moving towards the ocean with an immense subglacial stream emerging at the ice front, wherever that might have been. From phenomena observed in Glacier Bay I am led to credit the tradition of the Indians that within historic times these glaciers met and the Stikine River made its way under them through an immense tunnel.

From the mouth of the Stikine River northwards, glaciers in great numbers and of great size are seen coming down from the mountains towards the sea-level, while all the mountains upon the islands are snow-clad through the whole summer, and some of them contain glaciers of small size. At Holcomb Bay and Taku Inlet glaciers come down to the sea-level and send off numerous small icebergs, which are frequently met with in Stevens' Passage. At the head of Glacier Bay no less than four glaciers of great size come down to tide-level, sending off immense numbers of small fragments and bergs. The evidence here of the recent vast extension of these glaciers down the bay, and of the facility of glacier-ice in adjusting itself to the local topography, is of a most explicit and interesting character. The Muir Glacier, which is two miles wide at its mouth, is formed by the confluence of nine main streams, coming in majestic curves from the southeast, east, north, northwest, and west, and uniting in a vast amphitheatre of ice many miles in diameter a short distance above its present outlet. From the surface of this icy amphitheatre numerous islands project, as from the waters of an archipelago. The summits of these bear every mark of having been freshly uncovered by the decreasing volume of ice. Below the mouth of the glacier numerous islands in the bay present exactly the same appearance, except that they now project from water instead of ice. Their recent glaciation is indicated by every characteristic sign. Willoughby Island, about the middle of the bay, is as much as a thousand feet above the water. Were the ice to retreat a few miles farther, it would doubtless uncover an extension of the bay with numerous islands similar to those now dotting its surface south of the glacier. Fresh glacial débris lingers on the flanks of the mountains on either side of the inlet at a height of two thousand feet; and at three thousand seven hundred feet striæ were observed moving, not down the mountain, but parallel with the axis of the bay, showing that the present glacier is but the remnant of an ice-flow of similar character and direction of movement, but of vastly greater dimensions, extending and filling the whole bay to its mouth in Cross Sound, a distance of twenty-five miles. At Sitka the rocks in the harbor are all freshly striated, the direction of the movement being in a westerly direction, or towards the open sea. Glaciers still linger in the mountains at the head of the bay to the east of Sitka.

From all these facts it seems evident that we have only to suppose a slight increase of present forces favorable to the production of glaciers to find a state of things which will account for all the facts and unravel the whole intricate web of phenomena upon the western coast of North America.

The present formation of glaciers on the coast of Southeastern Alaska is favored not so much by the coolness of the climate as by the elevation of the mountains and the excessive amount of precipitation, which is not far from one hundred inches annually. There is no evidence that the elevation of the coast has materially changed in recent times. Nor is there evidence of any changes in the amount of precipitation. It would only be necessary to suppose a slight diminution of temperature to secure all the additional force required to extend the present glaciers of Southeastern Alaska, British Columbia, and of the Cascade Range in Washington Territory and Oregon, until they should occupy all the channels of the Alexander Archipelago, fill the space occupied by the Strait of Georgia between Vancouver's Island and the main-land, and cover the whole valley between Mount Rainier and the Olympian Mountains, where now we find the vast moraine deposits of the islands and shores of Puget Sound. Southward, in Oregon, the Willamette valley is filled in a similar manner by an extension of the glaciers still lingering on the flanks of Mounts Hood and Shasta. The absence of drift on the southern shore of Vancouver's Island seems to point to a termination of the northerly movement in the Strait of Juan de Fuca, where, perhaps, the confluent streams turned westward and sent off vast drift-laden icebergs to the sea. Mount Baker, immediately to the east of this point, is upwards of ten thousand feet high, and still preserves glaciers on its flanks, and would have aided greatly in this movement.

In the boulders about Puget Sound, and in the striated surfaces which must exist somewhere in the vicinity, there is doubtless positive evidence of the direction of the ice movement which brought to its present position the immense ridges and piles of glacial débris forming the fertile soil of this remarkable region. It is to be hoped that local observers will not long leave the world in doubt as to the source of the boulders and the direction of the striæ about Puget Sound. To me the shores and islands of that region had the appearance of being the terminal deposits of confluent glaciers coming down from the flanks of Rainier to the southeast, and from the lower portions of the Cascade Range farther north, joined by smaller glaciers from the Coast Range on the west. It is clear that the earlier glacial movements on the Pacific coast were local in character, and must be studied independently of those east of the Rocky Mountains. The ancient glaciers of the Pacific coast can be understood only by reference to the glaciers which still linger at the head of all its numerous valleys, inlets, and fiords. In these the investigator has his *vera causa* ever before his eyes to guide his steps and to assist his imagination.

PLATE XII.

MONACHUS TROPICALIS.

NOTES ON THE LIFE-HISTORY OF MONACHUS TROPICALIS, THE WEST INDIAN SEAL.

BY HENRY L. WARD.

WHEN in 1494 Columbus was cruising among the West Indies with his little caravels, searching for the ever-delusive route to the kingdoms of the Grand Khan, towards the latter part of August his vessels became separated, and in order to spy out if possible the missing ones he came to anchor near a tall rock lying south of the centre of Hayti and called by him Alto Velo.

Sailors were sent ashore with orders to climb to the top and look out for the other caravels. Unsuccessful in their search for them, on returning to the ship "they killed eight sea-wolves (seals) which were sleeping on the sands."

This West Indian seal was consequently the first observed American mammal larger than the Coypu or Cane-Rat that probably had been seen at Cuba.

The next notice that we have of it was written by Dampier in 1675; then follow Hill's account in 1843, Gray's in 1849, 1850, and 1874, and Gosse's in 1851. This comprises all accounts of which I am aware that, based upon specimens in hand, appeared previous to 1884. Dampier and Hill and Wilkie (Gosse's account) in 1846 have given us the only records of observations concerning the life of this seal. Since then all trace of it has been lost, two small skins in Mexico and a single young one in this country comprising all the specimens known to be in existence up to the time that we obtained others.

Last fall I had consummated a plan to try and find this seal, when, hearing from Professor F. Ferrari Perez, of the Mexican Geographical and Exploring Survey, that he had the same object in view, we decided to join forces. Accordingly, in November last we met by mutual appointment at the city of Campeche. The Triangles, or rather the East Triangle, was the point at which we had decided to make our first search for Monachus. This is in lat. 20° 55′ N., long. 92° 12′ W., or one hundred and eight nautical miles in a northwesterly direction from the nearest point of the Yucatan peninsula. Distant two or three hundred yards in a northeasterly direction from the east island lies what I shall designate as the North Triangle. The west island, distant seven and a half miles, was unvisited by us.

A brief description of the east and north islands, the ones at which we obtained seals, will be of interest as depicting one of the hitherto unknown habitat of this animal. They are of coral formation and surrounded by dangerous reefs that here and there have reached the surface, from twenty-seven to twenty-eight fathoms of water surrounding them. Meandrina, Millepora, and Madrepora were the three genera noticed, the former, by far the more common, forming the bulk of the islands and outlying reefs.

The East Triangle is an irregular oval in form, about half a mile in length by perhaps one hundred and fifty yards in greatest width. The northern part of the island is quite level, raised scarcely a yard above high tide, and consists of gleaming white coral sand interspersed with water-worn, rounded blocks of the same material.

These sandy portions of the islands were the principal "hauling-up" places of the seals. The southern part of the island is almost exclusively composed of these coral stones, strangely heaped up into pinnacles and ridges, about twenty feet above sea-level, between which lie gullies and circular pits six or seven feet in depth.

Beginning a little distance from the smaller end of this island, so as to include between itself and the land a narrow lagoon, runs a reef which, for its entire length awash, loses itself in the sea before it reaches the Northern Triangle. This island, of approximately half the area of the other, is quite similar to it in form and character. No trees or bushes grow upon either, three species of plants alone forming the observed vegetation. Two of these are trailing plants. The other, one of the Leguminoseæ, growing to a height of about two feet, formed sheltered nooks between the diverging stems, positions that were used as nests by the Booby (*Sula cyanops*) and the Man-o'-War-Bird (*Fregata aquila*). *Sterna maxima* was the only other bird noticed. Alacrans (scorpions) a black kind, abounded in the sandy places, causing one to be somewhat careful where he sat or what he picked off the ground. The house-fly completes the list of the air-breathing observed fauna.

Upon arriving at the islands we anticipated a stay long enough to enable us to do all the work both upon seals and other objects that we might desire; but on the second day the barometer indicated the near approach of a "Norther," the severe winter wind of that part of the coast, and upon the third day we had hurriedly to break camp, even leaving some of our specimens, get aboard of our little schooner and scud back to harbor amid the breaking waves and chilling blasts of a winter gale. My observations therefore cover a very small period of time,—*i.e.*, from the 1st to the 4th of December. This proved to be the time of parturition among the seals, for upon making a landing on the east island we killed a female with a fœtus nearly ready for birth, and in a little internal pond of salt water found a female lying on her side suckling her young. She paid no more attention to our near approach than would the familiar denizens of the barn-yard under similar circumstances. Subsequently four other females were killed containing nearly ripe fœtuses. In one case, where the fœtus was removed immediately after killing the mother, it kicked and squirmed for one or two minutes in such a lively manner as to indicate that delivery would have occurred in a few moments had the female not been molested. Following the usual order with seals, there is but one offspring at a birth. The female can have little difficulty in nursing this, as in any but a perfectly prone position one or more of her four teats will always be within reach of the young.

The fœtus is quite large, one measuring 85 c.m. in length from tip of nose to end of tail.[1] The hair is long, very soft and woolly, and of a glossy black color. Parturition probably occurs in shallow water, as the three females noted nearest this period were lying stranded on the beach, half in and half out of water.

The young seal previously mentioned was of a uniform black color, including its mystacial bristles, with large, dark brown, lustrous eyes that looked inquiringly at one: more intelligent in appearance than were the adults. This youngster we took with us on leaving the islands, and had it in captivity for a week or more at Campeche, where it eventually died, probably from lack of proper nourishment.

Its teeth were uncut, and so it had no thoughts of offering

[1] More measurements and descriptions of this seal will be found in a bulletin of the American Museum of Natural History, now in course of preparation by Professor J. A. Allen.

resistance when handled. It was totally devoid of fear; but most too young to make any demonstrations of friendship. Its time on shipboard was spent in aimlessly roaming to and fro, serenely regardless of such trivial obstructions as people standing in its way; uttering every few moments its cry, a long drawn out, guttural "ah," with a series of vocal hitches during its enunciation. At Campeche this little seal seemed to enjoy its daily bath in the sea, plunging its head under water and blowing and snorting as if in great glee, yet ever and anon uttering its plaintive cry, as if in momentary mourning for its lost parent.

Two females containing fœtuses measured respectively 2 m. 16 c.m. and 1 m. 99 c.m. from end of nose to end of tail. Two adult males measure from a skeleton and stuffed specimen respectively 2 m. 29 c.m. and 2 m. 16 c.m. between the same points. These are about the maximum sizes, of the two sexes, noticed. Such a seal looks large and might easily give rise to the "about ten feet in length," and even greater measurements, that have been reported of this species.

From the black pelage of the extremely young to that of the adult there is an intermediate stage of yellowish gray on the dorsal surface, shading to almost a perfect ochre on the ventral portions. Adults are grayish brown or grisled on the back, a result of the Vandyke-brown hairs being tipped with light horn-color, the lower surface ochreous-yellow to yellowish white. Females seem to have much less of the yellow or white on the ventral surface.

The variations in coloration in individuals of approximately the same age seemed to be comparatively slight. In adults the mystacial bristles vary from dark horn-color for the basal half and light horn or whitish for the remainder, to a clear light color for their entire length. They taper gradually to a remarkably fine point, for a half-inch, in some specimens, being scarcely heavier than a coarse human hair.

The head is very large and prominent, having an extremely "brainy" appearance even for a seal: quite belying its mental capacity, which seems to be very slight. This prominence is not so much on account of the size of the skull as because of the immense amount of muscle and flesh intervening between it and the skin. The whole body of the animal is very chunky. The bones are all deeply embedded in the flesh, over which, particularly on the belly, lies a thick coating of fat. The eye of the adult is an index to its mental capacity, for so dull is it that in the first specimen observed I was much inclined to think that this organ was diseased. The pupil is medium-sized, round, and well defined, the iris is light reddish brown, in color, and with but little of the sclerotic coat showing. Over the cornea there appears a deadening film, giving it much the same appearance as a glass eye or marble that has been so much handled as to lose its polish. May not this lustreless eye arise from the strong reflection of a tropical sun upon the coral sands? Most seals have a peculiarly soft, intelligent eye.

When lying with the head close to the ground, either in life or immediately after death, the shoulders appear more prominent than in any other seal with which we are familiar.

The whole character of this seal is that of tropical inactivity, exemplified by the peculiar circumstance that several of those collected had such a growth of minute algæ upon their backs and flippers, more especially the hinder ones, as to appear quite green. At no time does this seal raise its head as much above the line of its back as does the harbor seal: the flexibility of its cervical vertebræ appearing to be quite restricted. Upon first approaching them they appeared to have no dread whatever of the human presence, lazily looking at us, perhaps uneasily shifting their position, and then dozing off in restless sleep. Upon advancing to within three or four feet they would somewhat rouse themselves, bark in a hoarse, gurgling, death-rattle tone, and uneasily hitch themselves along a few paces. At first the seals offered very little resistance, and only upon the second day of our stay, when they had become somewhat accustomed to our presence, and when we made an onslaught upon a group of several, did they show fight at all. On this occasion their numbers and their being huddled together seemed to give them courage, as well as making our attempts to kill them with clubs and daggers (we had early decided not to use firearms, because of the danger of frightening them away from such small islands) dangerous and more or less abortive. Not infrequently would they make savage rushes for a yard or two at some one of our attacking party, and failing to reap revenge upon us would fall upon their dead or dying fellows, biting and shaking them in impotent rage; or occasionally two would engage each other in savage conflict for a moment or two, the heavy gnashing of their teeth as their powerful jaws closed giving us a lively idea of how unpleasant it would be to fall within their reach. Nevertheless, the whole aspect of the animals was one of indecision. Instead of stampeding when molested, they only roused themselves to action upon being individually attacked. As another illustration of their lack of intellectual acuteness, I may mention that on the following morning we found several seals that had "hauled up" during the night among the dead ones surrounded by skinned carcasses.

In the water they showed no particular curiosity in regard to a boat or its occupants, a curiosity usually so very marked among seals, nor did they disport themselves in play as does the harbor seal. That they are generally peaceful is borne out by their appearance, very few scars of combat being observed, and some of these not unlikely inflicted by the myriads of sharks surrounding the islands. The contents of the stomachs of several were examined, but nothing except fluids were found, which gave no clue to their food. It undoubtedly consists largely of fish: one in captivity was fed on this food and appeared to thrive well. They are greatly infested with intestinal parasites several inches in length, that shortly after death swarm out of anus and vagina, dying as they reach the air. On land or in shallow water the seal progresses by drawing forward the hind parts, thus throwing the line of the back into a strong curve, then pitching itself forward on to its breast to again repeat the same action. The distance covered is usually about a foot, the difference between the chord of the arc and the horizontal length between the fore and hind flippers; but when this movement is violent the seal throws itself forward with so much force as to somewhat overshoot this. The appearance of one moving is much like that of an "inch-worm,"—a continual bobbing up and down of the middle of the back. One was noticed that, when under considerable excitement, evidently forgot how to run, but lay on its belly trying to scull through the sand with its hind flippers as though it were in the water.

On the 29th of November last a small seal was captured alive near the city of Campeche; but as we were busy getting away we did not obtain it. On our return the purchaser tried to dispose of it to us for one thousand dollars! and on my departure for the north still held it at two hundred dollars. It was difficult to glean any exact data from the inhabitants; but I am inclined to believe that the seal is quite uncommon on the coast. The high price asked for the young one, and the fact that it was here placed on exhibition and afterwards taken to Progresso for the same purpose, would seem to confirm this.

About forty years ago, I am told, a vessel was wrecked at the Triangles, the captain and a negro, the only survivors, living upon seals and birds for six months before effecting their escape. Mr. W. B. Alexander, of Plymouth, Mass., writes me, under date of February 9, 1887, "In the spring of 1856 I was with Captain Lucas at the Triangles for a load of Mexican guano. I only saw two seals while there, which left the island in a hurry, so I can give you no information from personal knowledge, although there must have been great numbers there, by the skeletons, poor hides, etc.; and some one must have carried on an extensive business in that line, for we made a grand bonfire of perhaps a hundred barrels of the remains."

Mr. F. A. Lucas writes me from the United States National Museum, February 2, 1887, "In the spring of 1856 my mother was at the Triangles, where my father, A. H. Lucas, had gone in the bark 'Edwin,' of Charlestown, Mass., to seek guano. The young boobies were in downy plumage, and this is why I call it spring. My mother remembers seeing seals on the rocks, and seal-bones were found on the island."

Mr. Gosse, "A Naturalist's Sojourn in Jamaica," says that this seal has crimson irides, that "the hair prevails everywhere except on the palms of the flippers, which are bare," and "the color of the body is an intense uniform black." The first two points are evidently mistakes. The third is characteristic only of very young specimens of Monachus. Perhaps it is Gray's *Cystophora antillarum*, a species concerning which I am very sceptical.

But color seems to be a great stumbling-block with many. Mr. H. W. Elliott, usually so exact in description, in *Science*, vol. iv. pp. 752, 753, describes the specimen now in the National Museum as "intense ebony-black," while Messrs. True and Lucas, in Smithsonian Report, 1884, Part II., p. 332, in describing the same specimen, say, "In our specimen the hairs of the back and hind flippers appear light at the tips, as if faded by age; but are dark sepia color or nearly black, except at the extremity."

It is surprising how this seal has lived for so long a time in such a frequently traversed part of the ocean as the Gulf of Mexico, surrounded as it is on all sides by populous cities, and yet should for nearly four hundred years remain all but unknown. Naturalists are usually particularly acute in searching out rare specimens; but by some peculiar combination of circumstances this seal has eluded the many scientific expeditions heretofore made to these waters.

For a full description of this seal the reader is referred to the previously-mentioned bulletin of Professor Allen, to whose much more able hands this work peculiarly belongs, and to whom I have willingly resigned it.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

We most heartily approve the growing practice of using English names for the various fungi, especially those which are of interest to us economically. Such fungi must be discussed over and over again in the journals of the day; they must be talked about by farmers, gardeners, stock-growers; they must be described by teachers and popular lecturers. A few of these species which are bound to have this publicity have scientific names which can be readily adopted into English speech; but in the great majority of cases the scientific names cannot be used by the people, nor can they be in any way "anglicized" or modified into such forms as will bring them into every-day use. Thus, while the genus Bacterium has given us the accepted term Bacteria for a group of organisms, the allied genus Saccharomyces has not been nor ever will be anglicized. Possibly Mucor may come into common use, but Entomophthora never will; nor will Phytophthora, Podosphæra, Sphærotheca, Microsphæra, Erysiphe, etc. It is not too much to hope that gardeners will habitually speak of the "Ramularia" of the strawberry, the "Septoria" of the plum leaf, the "Peronospora" of the grape-vine, but is any one rash enough to expect to hear our vineyardists speaking familiarly of the Physalospora ("Black Rot"), the Cercospora ("Grape-leaf Blight"), or the Phyllosticta ("Grape-leaf Spot")?

English names, or names which can be readily used by English-speaking common people, must be devised by our writers upon the injurious fungi. But in order that confusion shall not arise among and be propagated by the botanists themselves, it is all-important that English names should be chosen with the greatest care. Several years ago this matter was talked over in the Botanical Club of the American Association for the Advancement of Science, and it was hoped that some good would come of it, but no report has yet been made by the committee then appointed.

Let us have, before the confusion proceeds further, a clear understanding among botanical writers as to the application of the terms Blight, Mildew, Rust, Smut, Scab, etc. Let the fungi of certain orders bear certain English names. Let us say "the Rusts" for the Uredineæ in general, and Wheat Rust, Maize Rust, Euphorbia Rust, Rush Rust, Bean Rust, etc., for the species. Let us no longer use the name "Rust" for other fungi. It is doubtful whether the use of a modifying term ought to be encouraged in the English names of groups, as, for example, the "Downy Mildews" for the Peronosporeæ, and the "Powdery Mildews" for the Perisporiaceæ. This compels us to use terms like "the Powdery Mildew of the Lilac," "the Downy Mildew of the Grape," etc., forms of expression which are not likely to become common.

There is opportunity here for the exercise of considerable ingenuity among our students of the fungi. In constructing such English or anglicized names, that most excellent rule, "Avoid very long names as well as those that are difficult to articulate" (Laws Bot. Nomen., Art. 36), should be strictly observed.—*C. E. B.*

A Louisiana planter, according to the public press, is importing a load of rabbits from Australia, for the purpose of stocking a game-preserve with that animal. The extreme fecundity of this species (*Lepus cuniculus*) is well known, and in Australia its introduction from England has done incalculable harm to the agricultural interests. Hence the Louisiana enterprise is looked on with considerable anxiety by some persons.

The prospective injury will depend on the management of his preserves by their owner. The Australian fauna is peculiar in the absence of carnivorous mammalia, and hence the increase of rabbits, kangaroos, etc., has little natural check excepting that of deficient food-supply. In the United States the case is far different. Here the opossum, raccoon, several species of weasels, foxes, and cats furnish an effective restriction to the increase of any form of animal life sufficiently large to attract their attention. If the keepers will permit the presence of these carnivora in the preserves there need be no fear of excessive increase of the rabbits, and quite a zoological garden might in this way be maintained.

RECENT LITERATURE.

Vines's Physiology of Plants.[1]—This important work has been before the scientific public for somewhat more than half a year, and has in that time received the critical attention of most of the vegetable physiologists. It has already taken its place as an admirable cyclopædia of vegetable physiology, from which the botanical lecturer can draw *ad libitum* in the preparation of his notes. This use of the book is much favored by its form, the various topics being treated in twenty-three "Lectures." With the exception of the tables, which in some parts of the book are pretty freely used, there is little in it to remind one of the usual text-book. The style is eminently that of the lecturer before an audience, and, while it is pleasant to read, one cannot help thinking that it might have all been given in the book in much less space. There is a notable absence of any indication of the scale upon which the figures are drawn in the illustrations, an oversight which we attribute to the emphasis of the "lecture" idea in the book.

The general sequence of subjects may be understood from the headings of the successive chapters, as follows: the structure and properties of the plant-cell; absorption, the movement of water in plants; transpiration, the food of plants; metabolism, growth, irritability, reproduction. In some cases several chapters or lectures are given to each topic; thus "irritability" is discussed in seven lectures, covering 226 pages, or very nearly one-third of the book.

In a work of this kind one may demand exactness of statement and a freedom from contradictions. It is puzzling to the reader to be told on page 22, that "in some cases it is evident

[1] Lectures on the Physiology of Plants. By Sidney Howard Vines, M.A., D.Sc., F.R.S., Fellow and Lecturer of Christ's College, Cambridge, and Reader in Botany in the University. Cambridge, at the University Press, 1886, pp. x., 710. With 76 figures in the text.

that the incrustation (on the surface of plants) has been formed by the evaporation of water holding the salt in solution, which had been excreted by the plant;" while on page 60 it is said that "there is no evidence to prove that a plant loses any of its mineral substances which it absorbs." In the table on page 106 the relative numbers of stomata upon the two surfaces of the leaf of the Lilac (*Syringa vulgaris*) are given as 100 for the upper, 150 for the lower surface, an error which is the more notable from the fact that the figures in the following column ("relative quantity of water transpired") lose their significance when brought into relation with the proper numbers (0 for the upper, 330 per square mm. of the lower surface).

On page 599 we notice with pain the careless use of the word "bud," in speaking of the soredia of lichens. The use of words in this loose way in a scientific work can be productive of bad results only. A bud is one thing, a soredium is an entirely different thing. On pp. 602 and 603 we find another batch of loose statements, from the description of the mode of spore-formation in Bacillus to the remark that "the teleutospores of these fungi [Uredineæ] are those which are formed in the autumn, at the close of the growing season."

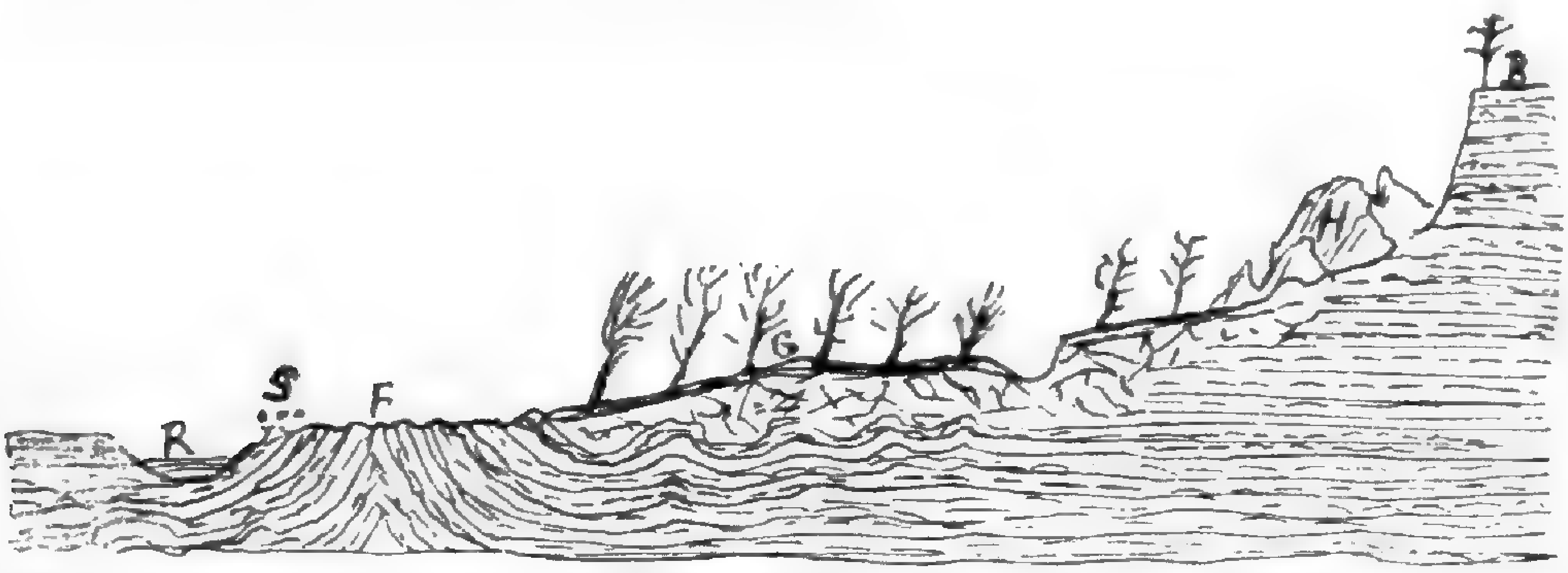
In spite of these blemishes and imperfections, the book is one calculated to do much to elevate the botanical work of the schools and colleges, and we trust that in this country its spirit and influence may be abundantly felt.—*Charles E. Bessey.*

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

A Landslide at Brantford, Ontario, illustrating the Effects of Thrusts upon Yielding Strata.—A landslide along the right bluff of the Grand River, about two miles southeast of Brantford, Ontario, which occurred at 6.45 P.M. of April 15, 1884, is worthy of notice as giving not only one of the best known illustrations of the structure of the Erie Clay of Ontario, but as showing the physical effects upon a smaller scale of lateral thrusts upon yielding strata.

At the point where the slide occurred the valley is about two miles wide, although some distance above and below it is much narrower. The sides of the valley rise about ninety feet above the flood plain, which is ten feet above the usual surface of the river. The upper twenty feet are composed of sandy Saugeen Clay (of Canadian geologists), in very thin regular beds, whilst the lower portion of the cliffs and that below the modern alluvium consists of Erie Clay. None of the underlying rocks of the Upper Silurian series are exposed. Owing to weathering, the surfaces of the Erie Clay soon cease to show their stratification. But here, after the slide, the great hummocks and pyramids—some ten feet or more in height, with bases as great or greater—have been bodily thrown out in great quantities, owing to the finely-jointed structure rarely shown in natural sections or artificial cuttings. The joints are mostly oblique to the bedding, yet some are perpendicular. These pyramids are composed of indurated beds of fine clay in layers of only an inch or two in thickness, easily splitting into slabs. The landslide, in this material, extended along the face of the bluff for seven hundred feet. A belt, eighty feet wide, was detached from the brow of the table-topped cliff, and in sinking sixty feet, caused the forward movement of a mass two hundred and forty feet wide, and anywhere from twenty-five to forty feet thick, between the lower part of the hill-side and the river, as shown in the diagram, which is across the western end of the slide.



R; bed of river; S, stones lifted by thrusts from bed of river; F, folds produced; G, grassy slope moved forward; H, hummocks from the face of the bluffs, B. Scale, one hundred feet to one inch.

Owing to the forward movement and reaction, the deposits of the Erie Clay have been raised into perfectly truncated anticlinal folds, which are composed of vertical strata more or less twisted. The vertical edges, where not concealed, are forty-four feet across, and on them—ten feet above the surface of the river—are resting the pebbles of the former bed of the stream now elevated.

Adjacent to the vertical strata at the western end of the slide rest the transported, but otherwise almost undisturbed, grassy sloping surface, with the trees still standing, but sloping at angles from twenty-eight to thirty-five degrees from the perpendicular towards the hill, as the present slope is that of a surface which formerly stood farther up the hill-side, at a higher angle. The junction of the former steeper and lower inclinations is now marked across the transported grassy surface by a deep longitudinal fissure. The eastern end of the slide consists only of a confused mass of hummocks and pyramids.

The landslide was due not to any undermining of the bluff, as the inclination of its lower part was at too low an angle, and the river two or three hundred feet away, but due to the hydrostatic pressure acting in the joints and along the smooth bedding of the clay, wherein the cohesion was reduced so as to allow the sinking of the brow of the bluff, and pushing forward a mass whose total volume was from half a million to a million cubic feet.

This landslide might almost be regarded as a gigantic laboratory experiment on plications, twistings, and thrusts, as shown in folded schistose rocks of mountain regions.—*J. W. Spencer, University of Missouri, Columbia, Mo.*

Age of the Niagara River.—The visit in August last of the Geological Section of the American Association to St. David's Valley,—adjacent to the Whirlpool of the Niagara River,—has drawn forth some notes upon this subject in the issues of *Science* for September 3 and 10, 1886.

In my various articles bearing upon the origin of the Great Lakes,—the most recent of which appeared in "Surface Geology of the Region about the Western End of Lake Ontario," *Canadian Naturalist*, 1882,—after having shown that the deep western end of Lake Ontario was due to subaerial erosion and streams,—among which was a great river flowing from the Erie Basin, with large tributaries from the highlands of the province of Ontario, cutting a cañon through the thick beds of limestones and shales of the Niagara escarpment to a depth of nearly one thousand feet—now partly submerged beneath Lake Ontario—and a width of over two miles,—I accounted for the drift-filled valley of St. David as being a portion of a channel of an interglacial Niagara River.

Subsequent observations of Dr. Julius Pohlmann (Proc. A. A. A. S., 1882) show that the eastern end of the Erie Basin is due to erosion by streams,—some of whose channels are now deeply buried near Buffalo,—which emptied into the Alleghany River, as it flowed northward from near Dunkirk, into the western end of Lake Ontario by the Dundas Valley. This great ancient water-way is now partly filled with drift, and is still more obscured by the warping of the rocks along the anticlinal between the two Great Lakes.

Upon further examination it will be found that the St. David's Valley is small, not only when compared with the great (Dundas) valley,—the old outlet of the Erie Basin,—but even with many other valleys cutting into the Niagara escarpment. Again, Professor Claypole's observation that rocks are found beneath the talus at a considerable height along the sides (at least) of the buried valley at the Whirlpool, restricts still more its probable depth. In short, the St. David's Valley is inadequate for the drainage of a great basin like that of Lake Erie.

Not even was the ancient representative of the upper portion of the Niagara River, above the Falls, of sufficient depth to drain Dr. Pohlmann's Buffalo Creek, for it flowed in a channel at least eighty-three feet beneath the present surface of Lake Erie, whilst the adjacent ice-scratched bed of the Niagara River, at the Buffalo International Bridge, is not more than forty-five feet beneath the lake surface.

Consequently, it appears that the St. David's Valley and such portions of the channel as those ice-scratched above the Whirlpool which remain, represent only the water-course or water-courses of local drainage before the Ice Age. This being the case, the ancient river did not recede deeply into the Niagara escarpment, and we are led to the conclusion that the cañon of the Niagara River, above the Whirlpool as below, is mostly of modern origin throughout, and not to any great extent an ancient drift-filled gorge, re-excavated since the Ice Age.—*J. W. Spencer, University of Missouri*, November, 1886.

Palæontological Observations on the Taconic Limestones of Canaan, Columbia County, N. Y.[1]—These researches occupied a little more than two days in June of this year, and were made in continuation of those previously reported, with the following results:

I. Thorough search was made in and around the farm of E. S. Hall, near Flatbrook, with the hope of finding in place the Trenton limestone which occurs here in large loose angular masses, filled with *Solenopora* (*Chætetes*) *compacta* and other minute corals. A ledge was found which may very likely contain altered nodules of this coral, but no positive evidence of its presence was obtained. The fossiliferous masses may well have come from ledges concealed under the deep drift which covers this farm.

II. An exceedingly interesting locality of richly fossiliferous limestone was discovered about two and a half miles to the north of Hall's farm. It is on the farm of Mr. Joseph Heminway, about a mile and a quarter northeasterly from the Canaan Four Corners Railway Station; it barely crops out at the surface, at the eastern foot of a very conspicuous limestone ledge lying immediately east of the farm buildings. Much of this rock is a mass of organic remains, most of which are finely comminuted fragments of crinoid columns mixed with portions of mollusc shells.

Though presenting a somewhat different set of the larger organisms, this stratum appears most probably identical with the fossiliferous limestone at the Canaan railroad tunnel, described in the *American Journal of Science* for April, 1886. The Hem-

[1] Abstract of paper presented before the American Association for the Advancement of Science, at Buffalo, August, 1886.

inway outcrop is, however, much the richer in fossils, of which the following have already been collected:

1. Crinoidal fragments in vast numbers.

2. Fragments of lamellibranchs, perhaps of the genus Lyrodesma.

3. Gasteropods of several genera and species. One of these is apparently a Holopea. Two or three other species which are very conspicuous on weathered surfaces have low spires and numerous whorls; some of these are from one to two inches in diameter, and have six or seven whorls. They look exceedingly like Ophileta, but may prove on careful examination to be Helicotoma or Pleurotomaria.

4. A single genal spine of a small trilobite.

There were found also, large calcareous plates, whose precise nature is not evident.

The general character of these organic remains indicates very decidedly the post-Cambrian origin of the strata; while, in spite of the Ophileta-like appearance of some of the Gasteropods, the presumption is strong that they belong to the Trenton epoch.

NOTE.—Subsequently to the presentation of the above paper, the continuation of these investigations at Canaan developed yet more important facts. In a limestone ledge on the Heminway farm, lying a little east of the fossiliferous outcrop above described, indications of Orthocerata were noticed; on following this outcrop northward a few hundred feet into the farm owned by Professor Charles Drown, quite a number of very interesting Orthocerata were discovered. These are finely preserved and distinctly characterized, showing admirably the septa and siphons. One of these is very nearly one foot long, and its shell is quite cylindrical, since the taper is exceedingly gentle. The septa in all are quite frequent, about fifteen to twenty to the inch. A well defined lituite was also found here.

These Orthoceratites are of the same general type as those occurring at Rockdale, near Poughkeepsie, N. Y., which from their character, and from their associate fossils, I consider as belonging to the horizon at present known as the Calciferous.

This, and the Trenton, therefore, appear to be associate components of the Canaan limestones.—*Wm. B. Dwight.*

MINERALOGY AND PETROGRAPHY.[1]

Volcanic Bombs.—In view of the fact that the volcanic bombs of Monte Somma present such a large variety of beautifully crystallized minerals in druses, and further, that in the case of the limestone bombs these minerals may well be supposed to owe their origin to the action of the hot lavas on pieces of limestone torn from the walls of the vent through which the lavas reached

[1] Edited by DR. W. S. BAYLEY, Madison, Wis.

the surface of the earth, it is a matter of no little surprise that sections of these bombs have not been more thoroughly investigated by means of the microscope and the other appliances now so generally made use of in the attempt to discover the origin of rocks and minerals. The most satisfactory article which has thus far appeared on this subject is that of Bruno Mierisch,[1] working under the supervision of Professor Zirkel at Leipzig. Eighty specimens of these bodies belonging to the collection of the University of Leipzig were examined. As might be expected, the results reached are exceedingly interesting. According to Mierisch the bombs may be divided into two great classes: (1) those consisting of broken pieces of older lavas, which are included in the younger lavas, and (2) the limestone or silicate bombs, in the druses of which the crystallized minerals, as mentioned above, are found. It is to the latter class that the present writer confines his attention. This class can be subdivided into limestone bombs and silicate bombs, and the latter of these again into (1) those in which the minerals are zonally arranged, and (2) those in which this arrangement is wanting. Under the microscope the limestone bombs are seen to consist of grains of calcite and an olivine mineral, which analysis proves to be forsterite,—the pure magnesium olivine. A noteworthy fact in this connection is the entire absence of even a trace of calcium in the forsterite, and the existence of the merest trace of magnesium in the closely-associated calcite. When druses occur in these limestone bombs their walls are formed of successive layers of magnesium mica (meroxene) and augite, upon the second of which the true druse minerals appear. With the increase in the size of the mica and augite zones the limestone bombs pass gradually into the zonally arranged silicate bombs, which consist of successive zones of olivine (mixed with a few grains of calcite and spinel), mica, and augite, upon the latter of which again the druse minerals proper are found. The second class of silicate bombs, to which belong the well-known sanidine bombs, is composed almost entirely of minerals found only in the druses of the limestone and zonal silicate bombs, and hence are probably merely druse fillings.

After treating in a general manner of the structure and classification of these bodies, Mierisch takes up separately each mineral occurring in them, and describes in detail its appearance, microscopical characteristics and associations. Here again we find many items of exceedingly interesting information, only the most important of which can be noticed. In the calcite of the limestone bombs glass inclusions were detected. These, according to the author, cannot be considered as secondary in origin, because not a trace of glass was detected in the ground-mass of any section examined. Consequently the calcite must have

[1] Tschermak's Min. u. Petrogr., Mitth. viii., 1886, p. 114.

included these in its crystallization from a molten magma. Porphyritic biotite crystals were seen to be surrounded by a rim of little augite crystals, evidently an alteration product, since in the immediate vicinity of the augite the biotite was bleached. In the olivine, fluid inclusions containing crystals of salt were detected. In some of the hauyne crystals inclusions of pyrrhotite were observed. It was noticed that as decomposition of these inclusions proceeded the substance of the hauyne became of a deeper blue color. The inference drawn by the author is to the effect that the sulphur freed by this decomposition is the agent which produces the blue coloration.[1]

Petrographical News.—About a year ago reference was made in these notes to the work of Hatch[2] on the andesites of Peru. The same author has continued his work, and now appears with a paper[3] on the rocks of the volcanoes in the neighborhood of Arequipa, a town in the southern part of Peru, about twenty miles from the Pacific coast. These rocks consist of andesites in all varieties, from the typical hornblende andesite, through intermediate varieties, to the rock containing augite as its only bisilicate constituent. Hypersthene occurs very widespread in the lavas of all the volcanoes in this region. Particular pains were taken to identify this mineral in a manner to preclude the possibility of error, and it was found that the only reliable means of distinguishing it from monoclinic augite consisted in the determination of the position of the optical axes. In almost every case where hornblende was present it was found to be surrounded by an opacitic rim, outside of which was occasionally seen a second rim of augite microlites. The high percentage of silica noticed in certain of the specimens was proven to be due to the silicification of the rock by the impregnation of its constituents by opal.——The Ponza Islands, off the west coast of Italy, are comprised[4] principally of trachytes, rhyolites, and tufas. An interesting point in connection with the trachyte of the island of Ponza is the occurrence of olivine in it. Glaucophane is supposed to occur in that of San Stefano. The tufas contain pebbles and pieces of quartz in addition to the broken crystals of various minerals. The ground-mass of the quartz trachyte from San Pietro,[5] off the southwest coast of Sardinia, consists of chalcedonic substance, in which are grouped little fibres of chalcedony in radial aggregates. Rhyolite, obsidian, and perlite are also found there.——In the diabase porphyrite from Petrosawodsk,[6] in Russia, about three hundred miles northeast of St. Petersburg, the porphyritic feldspar crystals are composed of parallel growths

[1] *Cf.* Vogelsang, Ueber natürliche Ultramarinverbindungen.

[2] American Naturalist, February, 1886, p. 161.

[3] Mineralog. u. Petrog., Mittheil. vii., 1886, p. 308.

[4] F. Eigel, ib., viii., 1886, p. 73.

[5] Ib., p. 62.

[6] C. v. Vogdt, ib., p. 101.

of oligoclase, labradorite, and orthoclase. These crystals, moreover, have undergone an unusual alteration into an aggregate of colorless prismatic needles of a uniaxial mineral, which occur either radially grouped or scattered indiscriminately in the mass of their otherwise apparently unaltered host. Their nature could not be determined, but an analysis showed that the alteration is attended with loss of silica and potassium and addition of aluminium. The ground-mass of the rock contains numerous little plagioclase crystals and grains of epidote, which v. Vogdt thinks were derived from the substance of the ground-mass by hydro-chemical processes.——Certain conglomeratic, granitic, and felsitic rocks occurring in Pembrokeshire, England, which Mr. Hicks[1] thinks are pre-Cambrian in age, have recently been described by Bonney.[2] The so-called felsites from Trefgarn are, according to this author, hälleflintas of volcanic origin, consisting of acid lavas and their associated ashes, which have been permeated by hot water, containing silica in solution, and have thus been silicified by the replacement of their feldspathic constituents by chalcedonic quartz.——The greenstones of St. Minver, Cornwall, have been separated by Rutley[3] into two distinct varieties. The first embraces those rocks which were once glassy basalts or andesites, but which have undergone decomposition with the production of bands and "small knots" of felsitic material, separated by bands of serpentine or palagonite. In the felsitic portion are small circular and lenticular areas of quartz and serpentine, which the author regards as the fillings of original vesicles. The second class described is of much fresher rocks. These contain large areas of augite, polarizing as a single individual, in which are included small crystals of plagioclase. [This same structure has been described frequently by American petrographers[4] under the term "lustre-mottling" (Pumpelly and Irving) and "poicilitic structure" (Williams).] Aggregates of augite, plagioclase, ilmenite, and a few accessory and secondary minerals make up the entire rock. The author calls it an augite-andesite.——In an appendix to an article by Mr. Durham[5] on the volcanic rocks of Fife, Professor Judd describes altered augite and enstatite andesites, in which the porphyritic pyroxene crystals occur in groups, and also porphyritic and perlitic mica-dacite glasses. In the base of the latter feldspar microlites and trichites are arranged in flowage lines. When heated before the blow-pipe a splinter of this rock lost 8.9 per cent. of its weight, and attained a bulk eight or ten times as great as that of the original fragment, producing a pumice which readily floated on water. The author concludes his paper with a dis-

[1] Quart. Jour. Geol. Soc., xlii., August, 1886, p. 351.
[2] Ib., xlii., August, 1886, p. 357. [3] Ib., xlii., August, 1886, p. 392.
[4] *Cf.* American Naturalist, March, 1886, p. 275.
[5] Quart. Jour. Geol. Soc., August, 1886, p. 418.

cussion of the several stages in the alteration of pyroxene andesites, as illustrated by the specimens examined. In the case of the mica-dacite glasses, alteration begins along the perlitic cracks, when it produces globiform masses, and then gradually extends outward until the entire body of the rock becomes white and opaque and appears to be isotropic. The author thinks that this alteration product may be a hydrated acid glass, corresponding to the palagonite of basic rocks.——In a recent article in which are given the results of the analyses of many of the phyllites and of the sericite, ottrelite, and hornblende schists of Belgium, Klement[1] says that the laterite from the Congo is a conglomerate consisting of sandstone pebbles cemented by limonite or some other hydrated oxide of iron.——In a letter to the *Neues Jahrbuch für Mineralogie*, Siemiradski[2] describes three anorthite rocks from the island of St. Thomas, one of the Antilles. One is a corsite with a ground-mass saturated with secondary opal, which has been produced by the decomposition of the other constituents. The other two are dyke rocks cutting the corsite. They can be best characterized as altered anorthite andesites.

Mineralogical News.—The optical investigations of Langemann[3] on harmotome, phillipsite, and stilbite seem to indicate that these three minerals are triclinic in crystallization instead of monoclinic as has heretofore been supposed. According to this view the twinning laws of these minerals are: (1) twinning planes $\infty P \check{\infty}$ and OP, giving rise to interpenetration fourlings with an orthorhombic symmetry; (2) two fourlings twinned according to the plane $P\check{\infty}$ produce eightlings, with a quadratic symmetry; and, finally (3), three eightlings with ∞ P as their twinning plane yield twenty-fourlings with a regular symmetry.——By observing the forms of the figures which are produced on the cubic faces of sylvite, when it is exposed to the action of moist air, R. Brauns[4] has succeeded in showing that the crystallization of this mineral is like that of cuprite and salammoniac, in the gyroidal hemihedral division of the regular system. The bromide and the iodide of potassium crystallize similarly.——In a late number of the fourth Beilage Band of the *Neues Jahrbuch für Mineralogie* H. Schedtler[5] has an elaborate paper on the thermo-electrical relations of tourmaline. The paper opens with an historical introduction to the subject, in which the results of many earlier investigations are given. Then follow descriptions of the methods in use for the detection of electricity in minerals, and some general considerations, after which the author describes his own results based upon the examination of sixty-

[1] Min. u. Petrogr., Mitth. viii., 1886, p. 1.
[2] Neues Jahrb. f. Min., etc., 1886, ii. p. 175.
[3] Ib., p. 83. [4] Ib., vol. i. p. 224.
[5] Ib., Beil. Band iv., 1886, p. 519.

seven crystals, from almost every known locality in which this mineral is found. These results are embraced under fifteen heads. Under one of these he states that the electrical activity is greater in the green, brown, and red crystals than it is in black or colorless ones; and that the black crystals often show no electrical phenomena, but, on the other hand, are conductors of electricity. ——The same subject has been treated in a paper by E. Riecke in the *Annalen der Physik und Chemie.*[1]——In his study of Brazilian topaz K. Mack[2] has found that the electrical axis does not correspond to any crystallographic axis, and that in cases where the crystallographic axis does not exactly bisect the optical angle, this anomaly is accompanied by abnormal extinctions in the plane of the optical axes.

BOTANY.[3]

The Study of Plant Diseases.—Although the fungi themselves have been studied in this country for many years, the diseases they produce have hitherto received little attention. One would have supposed that from the thirty or forty agricultural colleges and agricultural departments of colleges in the United States something might have come, but the returns from these institutions have been as meagre as from other sources. Doubtless one great reason for this barrenness of results has been the want of time on the part of the professors of botany. With the burden of many classes always upon them, and often the almost total absence of collections, books, and instruments, the professor of "science" has had indeed a hard road, and it is a cruelty to blame him for not being productive. But with these allowances, it must be confessed that botany is often taught by men almost wholly unacquainted with the subject. It is by no means an unusual thing to find professors teaching botany whose knowledge of the subject stops short of the ability to handle the Compositæ. The Grasses and Sedges, to them, are little better than "Cryptogams," and as to the latter, they are simply Cryptogams. From such botanists no study of plant diseases need be expected.

Two recent publications ought to direct the attention of our botanists to this much-neglected field. Mr. Arthur's report, as botanist of the Agricultural Experiment Station at Geneva, N. Y., shows where and how good work may be done by those competent to do it. Among the topics taken up are Pear Blight, Rotting of Tomatoes, Mildew of Strawberries, Plum-leaf Fungus. Aside from its economic value, the report is valuable as indicating better methods of work in botany. Let any one read over the pages treating of the Pear Blight, and he cannot help feeling that the work there recorded is of a much higher order than that

[1] No. 5, 1886, p. 43. [2] Annalen der Physik und Chemie, No. 6, 1886, p. 153.
[3] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

usually considered as belonging to the botanist. The work here recorded is entitled to be called strictly scientific.

The second publication is Mr. F. L. Scribner's "Fungus Diseases of the Grapevine," issued by the Department of Agriculture at Washington, D. C. Its principal contents are the Downy Mildew (*Peronospora viticola*), Powdery Mildew (*Uncinula spiralis*), Black Rot (*Physalospora bidwillii*), Anthracnose (*Sphaceloma ampelineum*), Grape-leaf Blight (*Cercospora viticola*), Grape-leaf Spot (*Phyllosticta labruscæ*). Some good plates accompany the text, and add much to its value. As with the preceding report, this one ought to show our younger botanists that there is an opportunity for them to do good work in botany even.—*Charles E. Bessey.*

Vegetable Pathology.—Agriculture demands of botany a knowledge of the pathology of vegetation. It is not enough that the normal action of all parts of the plant should be understood; the abnormal and diseased actions must also be considered. Unfortunately, the world is full of accidents, of noisome gases, of poisonous liquids, of freezing or scorching temperatures, of harmful insects, and of destructive fungi. The plant which is more or less affected by one or all of these is not the normal plant of the vegetable physiologist. The vegetable pathologist must build his science upon that of his fellow-worker in vegetable physiology, and the results of the labor of both must be laid before modern agriculture for its use. That botany which hopes to satisfy the demands of the advanced agriculture of to-day must include a knowledge of pathology.—*Proc. Soc. for Promotion Agr'l Sci.*

Botanical News.—From Dr. A. N. Berlese we have a paper on a new Pyrenomycetous genus, Protoventuria, represented by a single species, *P. rosæ* Berl. (= *Venturia rosæ* De Notaris). A good plate accompanies the paper.——The old genus Phoma has been divided, and a new genus, Macrophoma, has been erected by Doctors Berlese and Voglino (*Atti della Societa Veneto-Trentina di Scienze Naturali*, vol. x.). The new genus also includes species formerly referred to Sphæropsis and Sphæronema. Ninety-nine species are enumerated, twenty-one of which are figured upon the accompanying plates.——Doctors Berlese and Voglino have published a volume of Additamenta to Volumes I. to IV. of Saccardo's "Sylloge Fungorum." It includes nineteen hundred and thirty-seven species. These additions to the Sylloge bring up the number of species to the following, viz.: Pyrenomyceteæ, 7564; Sphæropsideæ, 4078; Melanconieæ, 606; Hyphomyceteæ, 3664; making a grand total of 15,912 species. ——A recent paper on Certain Cultures of Gymnosporangium, with notes on their Rœsteliæ, presented by Roland Thaxter to the American Academy of Arts and Sciences, contains much of interest to the mycologist. As a result of these cultures the author of the paper concludes to connect the species of Gymnosporangium and Rœstelia as follows: *G. conicum*, with *R. cornuta*; *G. claviceps*, with *R. aurantiaca*; *G. clavariæforme*, with *R. lacerata*; *G. macropus*, with *R. pyrata*; *G. biseptatum*, with *R. botryapites*; *G. ellisii*, with *R. transformans*, probably. The Rœstelia of *G. globosum* is still left in doubt.——H. N. Patterson, of Oquawka, Ill., has brought out a handy check-list of North American Plants, including Mexican species which approach the United States boundary. It will prove very serviceable.——Cooke's "British Desmids" has reached the seventh number, and continues to maintain its high character. When completed it will form an excellent companion volume to Wolle's "Desmids of the United States."——Part III. of Macoun's "Catalogue of Canadian Plants" is devoted to the Apetalæ, including the Coniferæ. About one hundred pages are devoted to additions and corrections to Parts I. and II., while a very full index completes the volume. The publication is creditable to the Geological and Natural History Survey of Canada. It is to be hoped that the work will be continued.——The Eriogonous genus Lastarriæa Remy, has lately been studied by Dr. Parry, who confirms its generic rank. Three species are characterized, viz.: *L. chilensis* Remy of the Pacific Coast of North and South America; *L. stricta* Philippi, ined., from Chili; *L. linearis* Philippi, ined., Chili.——An interesting paper, by Thomas Meehan, on the Fertilization of *Cassia marilandica*, received some time ago, has been noticed before in these pages. The author found that not a single seed was produced when the flower was protected from the visits of insects.——Dr. Beal's "Lessons on Growing Forest Trees," in a late Bulletin of the Agricultural College of Michigan, possesses botanical as well as horticultural interest. ——Dr. Gray's Botanical Contributions (Proc. Am. Acad. Arts and Sciences, vol. xxi. pp. 363 to 413) includes besides a much needed revision of the North American Ranunculi, descriptions of plants from Northern Mexico, mainly from the collections made by C. C. Pringle and Dr. Edward Palmer. In referring to the need of a revision of the Ranunculi, the statement is made that "almost half a century ago the North American species of Ranunculus, as then known, were hastily compiled for Torrey and Gray's Flora, with very little knowledge of original materials; and they have not been elaborated since."——Numbers 146 and 147 of the *Journal of the Linnean Society* contain papers on the Mosses and Hepaticæ of Central Africa, by Wm. Mitten; Note on Balanophora, by Henry Trimen; a report on the Vegetation of Diego Garcia, by W. B. Hemsley, and the Forms of Seedlings, by Sir John Lubbock. The last will be noticed more fully in these pages hereafter.——The *Gardeners' Chronicle*

PLATE XIII.

ORGANS OF SMELL IN INSECTS.

(London) has been reduced in price, now costing American subscribers about $4.60. The pages have been reduced slightly in size, and some changes have been made in the type and heading. This valuable journal (to botanists as well as to horticulturists) now enters upon its third series.

ENTOMOLOGY.

Hauser on the Organs of Smell in Insects.[1]—Although Hauser's researches have been published in Germany several years, they were so carefully made and conclusive that our readers will, we feel sure, be glad to have laid before them in detail the facts which prove so satisfactorily that the antennæ of most insects are olfactory rather than auditory in their functions. Kraepelin in 1883 confirmed Hauser's views, and recently Will has published an excellent paper on the organs of taste in insects, especially wasps, etc., so that our knowledge of the senses of Arthropoda has been greatly extended and cleared up within the last few years. It now appears that few insects are known to have genuine ears, those of the locusts and grasshoppers being alone proved to be auditory organs. It appears that most insects (the sound-producing ones excepted) are probably deaf, while nearly all have very acute senses of smell, taste, and touch.

That many insects possess an unusually acute sense of smell no naturalist disputes. A point in debate, however, is the site of the organ of smell in these animals. The author attempts to settle the question.

I. *Physiological Experiments.*—First of all one should observe as exactly as possible the normal animal in its relation to certain smelling substances, whose fumes possess no corrosive power or peculiarities interfering with respiration; then remove the antennæ and try after several days to ascertain what changes have taken place in the relation of the animal to the substance. In order to come to no false results it is often necessary to let the animals operated upon rest one or two days, for immediately after the operation they are generally so restless that a careful experiment is impossible.

The extirpation of the antennæ is borne by different insects in different ways; many bear it very easily, and can live for months after the operation, while others die in the course of a few days after the loss of these appendages. The animals seem to be least injured if the operation is performed at a time when they are hibernating. *Pyrrhocoris apterus* L., and many other insects, afforded a very striking proof of this relation.

Experiments made by placing the antennæ in liquid paraffine so as to cover them with a layer of paraffine, thus excluding the air, gave the same result as if the antennæ had been removed.

[1] Zeitschrift für Wissenschaft. Zoologie, xxxiv., 1880. Three plates.

The experiments may be divided, according to their object, into three groups. Experiments of the first kind were made on insects in their relation to strong-smelling substances, as turpentine, carbolic acid, etc., before and after extirpation of the antennæ. The second group embraces experiments on the relation of animals as regards their search for food; and finally the third group embraces experiments on the relation of the sexes relative to reproduction before and after the extirpation of the antennæ.

1. *Relation of insects to smelling substances before and after the loss of their antennæ.*—Taking a glass rod dipped in carbolic acid and holding it within 10 cm. of *Philonthus æneus*, found under stones at the end of February, it raised its head, turned it in different directions, and kept making lively movements with its antennæ. But scarcely had Hauser placed the rod close to it when it started back as if frightened, made a sudden turn, and rushed, extremely disturbed, in the opposite direction. When he removed the glass rod the creature busied itself for some time with its antennæ, while it drew them, with the aid of its fore limbs, through its mouth, although they had not come into direct contact with the carbolic acid. There was the same reaction against oil of turpentine, and it was still more violent against acetic acid.

After having many times carefully tested the relations of the normal animal to the substances mentioned, the antennæ were removed from the socket-cavity.

On the second day after Hauser experimented with the insects, they exhibited no reaction either against the carbolic acid, the oil of turpentine, or also against the acetic acid, although he held the glass rod which had been dipped into it for one or two minutes before and over the head. The creatures remained completely quiet and immovable, at the most slightly moving the palpi.

They showed otherwise no change in their mode of life and their demeanor; they ate with great eagerness flesh which had been placed before them, or dead insects, and some were as active as usual as late as May.

These beetles had, as proved by the experiments, lost the sense of smell alone; how far the sense of touch was lost Hauser could not experimentally decide.

The same results followed experiments with species of the genus Ptinus, Tenebrio, Ichneumon, Formica, Vespa, Tenthredo, Saturnia, Vanessa, and Smerinthus; also many species of Diptera and Orthoptera, besides Julus and Lithobius, while many larvæ reacted in the same manner.

Less satisfactory were the experiments with Carabus, Melolontha, and Silpha; there is no doubt that the species of these genera, through the extirpation of their antennæ, become more or less injured as to the acuteness of their powers of smelling; but they never show themselves wholly unable to perceive strong-smelling substances.

The allurement of the substance acts for a longer time on those deprived of their antennæ, then they become restless, then they wander away from the glass tube held before them; still all their movements are but slightly energetic, and the entire reaction is indeterminate and enfeebled.

Experiments with the Hemiptera gave still more unfavorable results; after the loss of their antennæ they reacted to smells as eagerly as those did which were uninjured.

2. *Experiments on the use of the antennæ in seeking for food.*—Under this head experiments were made with Silpha, Sarcophaga, Calliphora, and Cynomyia.

Silpha and its larva were treated in the following manner: they were placed in large boxes whose bottoms were covered with moss, etc.; in a corner of the box was placed a bottle with a small opening, in which was placed strong-smelling meat. So long as the beetles were in possession of their antennæ they invariably after a while discovered the meat exposed in the bottle, while after the loss of their antennæ they did not come in contact with it.

In a similar way acted the species of Sarcophaga, Calliphora, and Cynomyia. Hauser, in experimenting with these, placed a dish with a large piece of decayed flesh on his writing-table. In a short time specimens of the flies referred to entered through the open window of the room. The oftener he drove them away from the meat would they swarm thickly upon it. Then closing the window and catching all the flies, he deprived them of their antennæ and again set them free. They flew about the room, but none settled upon the flesh nor tried to approach it. Where a fly had alighted on a curtain or other object, the decayed flesh was placed under it so that the full force of the effluvium should pass over it, but even then no fly would settle upon it.

3. *Experiments testing the influence of the antennæ of the males in seeking the females.*—For this purpose Hauser chose those kinds in which the male antennæ differ in secondary sexual characters from those of the female, and in which it is known that they readily couple in confinement, as *Saturnia pavonia*, *Ocneria dispar*, and *Melolontha vulgaris*. The two first-named insects did not couple after the extirpation of their antennæ. Of *Melolontha vulgaris* twenty pairs were placed in a moderately-sized box. On the next morning twelve pairs of them were found coupling. Hauser then, after removing the first lot, placed a new set of thirty pairs in the same box, cut off all the antennæ of the males and those of a number of females. On the following morning only four pairs were found coupling, and at the end of three days five others were observed sexually united.

From these experiments Hauser inferred that those insects deprived of their antennæ were placed in the most favorable situation, such as they would not find in freedom; for the space in which the insects moved about was so limited that the males and females must of necessity meet. But at the same time the results of the experiments cannot absolutely be regarded as proving that the males, after the loss of their antennæ, were then not in condition to find the females, because in the case of the above-mentioned moths, under similar conditions, after the extirpation of the antennæ no sexual union took place. If, however, the experiments made do not all lead to the results desired, Hauser thinks that the results agree with those of his histological researches, that in the greater number of insects the sense of smell has its seat in the antennæ. His results also agree with those of Perris.

II. Histological Researches on the Organs of Smell in Insects.—The organs of smell consist, in insects,—*i.e.*, all Orthoptera, Pseudoneuroptera, Diptera, and Hymenoptera, also in most Lepidoptera, Neuroptera, and Coleoptera,—

1. Of a thick nerve arising from the brain which is sent into the antennæ.

2. Of a sensitive apparatus at the end, which consists of staff-like cells, which are modified hypodermis cells, with which the fibres of the nerves connect.

3. Of a supporting and accessory apparatus, consisting of pits, or peg- or tooth-like projections filled with a serous fluid, and which may be regarded as invaginations and outgrowths of the epidermis.

Hauser adds a remark on the distribution of the pits and teeth in the larvæ of insects, saying that his observations are incomplete, but that it appears that in the larvæ the teeth are most generally distributed, and that they occur not on the antennæ alone, but on the palpi; but in very many larvæ neither pits nor teeth[1] occurred. In the Myriopoda teeth-like projections occur on the ends of the antennæ. In Lithobius they form very small, almost cylindrical, pale organs.

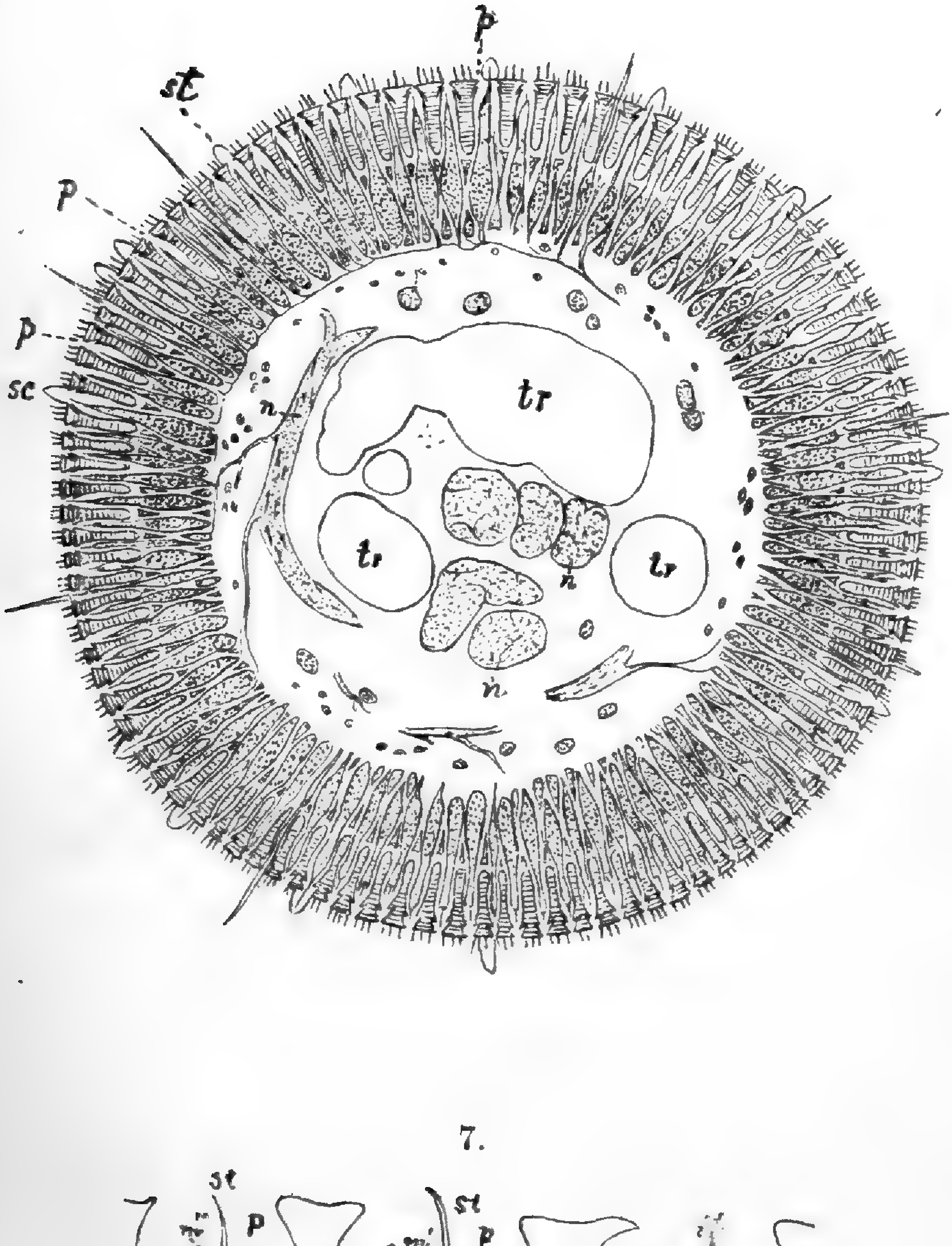
In the course of a special description of these sense-organs in the Orthoptera, Hauser describes at length those of *Œdipoda cærulescens* and *Caloptenus italicus*. On one antennal joint of Caloptenus was often counted fifty pits; on the anterior joints the number diminishes to about thirty. Hauser thinks that in all Orthoptera whose antennæ are like those of Caloptenus occur similar pits, as he found them in Stenobothrus as well as Œdipoda. Gryllotalpa possess similar pits,—four to six on each antennal joint, making between three and four hundred pits on each antenna.[2] In *Mantis religiosa* the pits were not detected,

[1] Hauser here uses the word *taster*, but this means palpus or feeler. It is probably a *lapsus pennæ* for teeth (*Kegel*).

[2] In 1870 I observed these sense-pits in the antennæ, and also the antenna-like anal

PLATE XIV.

6.



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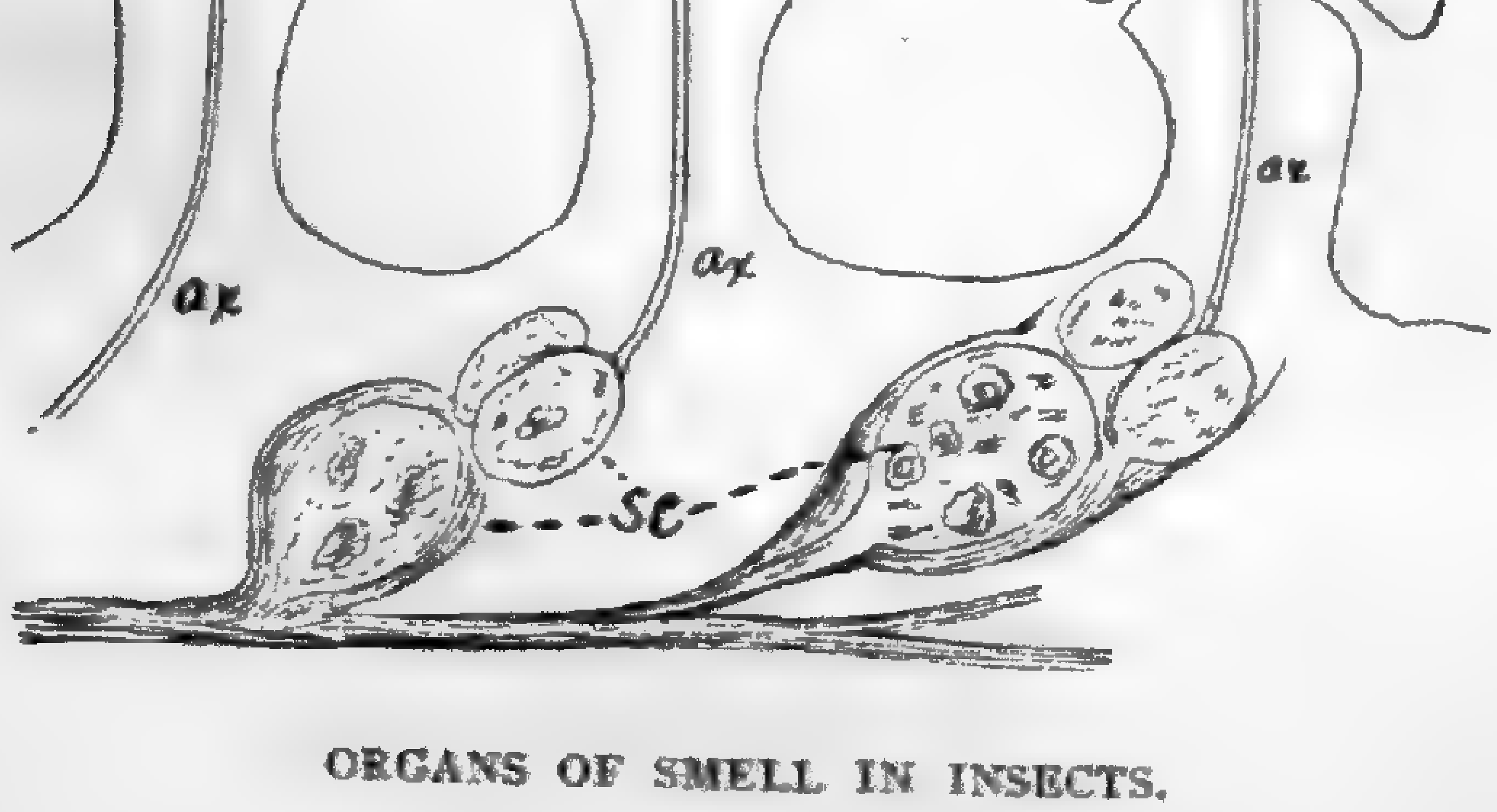

ORGANS OF SMELL IN INSECTS.

but on each joint, except the eight basal, there are about two hundred small, hollow-curved teeth with a fine opening in front.

In the Neuroptera (Chrysopa) there occur on the antennæ, besides numerous very long tactile bristles, small pale, transparent teeth. No pits could be detected.

In the Hemiptera (two species of Pyrrhocoris only were examined) only two kinds of tactile bristles occurred, but Hauser detected no pits, though Lespés states that they are present.

Of the Diptera, Hauser examined more than sixty species. The pits in the *Diptera brachycera* (Muscidæ, etc.) are unexceptionally confined to the third antennal joint. Their number varies extraordinarily in the different species. *Helophilus florens* has on each antennal disk only a single pit, while *Echinomyia grossa* possesses two hundred of them. In flies of certain families the pits are compound and contain ten, twenty, and often one hundred olfactory hairs, partly arising from the coalescence of several pits. Such pits are usually divided by lateral walls into several chambers, whose connection is only indicated by their common outlet. Simple olfactory pits with a single olfactory style were observed only in the Tabanidæ, Asilidæ, Bombylidæ, Leptidæ, Dolichopidæ, Stratiomydæ, and Tipulidæ. In the last the compound forms do not occur at all, but in the other families mentioned also occur compound pits, receiving from two to ten nerve-terminations.

The antennal pits of flies are always sac-like invaginations of the external chitinous integument, of manifold shapes, opening externally and never closed by a membrane. The pits differ but slightly in the different species, and that of *Cyrtoneura stabulans* (Fig. 2) is described at length as typical of those of brachycerous flies in general.

The olfactory pits of the Tipulidæ seem to have a somewhat different structure, since the external passage is closed. It is circular, surrounded with a slight chitinous wall and not covered with bristles. Such pits in their external appearance are like those of the locust (Caloptenus) and many Hymenoptera. They are situated usually on the third antennal joint. *Pachyrhina pratensis* L. has about sixty of them, as have *Tipula oleracea* L. and Ctenophora.

In the Lepidoptera, olfactory pits are much like those of flies. Hauser describes in detail those of *Vanessa io*. Those of the moths were not examined, but they can be readily and satisfactorily proved to be the site of the olfactory sense.

appendages (cercipoda) of the cockroach (*Periplaneta americana*). I counted about ninety pits on each stylet. They are much larger and much more numerous than similar pits in the antennæ of the same insect. I compared them to similar pits in the antennæ of the carrion-beetles, and argued that they were organs rather of smelling than hearing. (AMER. NAT., iv., Dec. 1870.) Organs of smell in the flies (Chrysopila) and in the palpi, both labial and maxillary, of Perla were described in the same journal.—*A. S. P.*

Historical researches in the Coleoptera generally gave a very unfavorable result, contrary to Lespés's views. That author states that in the Carabidæ the pits are found on the four first joints, but Hauser could discover them in none which he examined. Usually only tactile bristles occur, so also in the Cerambycidæ, Curculionidæ, Chrysomelidæ, and Cantharidæ.

Olfactory pits, however, without doubt occur in Silpha, Necrophorus, Staphylinus, Philonthus, and Tenebrio. The openings of the pits are small and surrounded with a small chitinous ring; in Silpha, Necrophorus, and Tenebrio they cannot easily be distinguished from the insertion-cavities of the bristles, but in Philonthus and Staphylinus they are less like them, being distinguished by their somewhat larger size and their often more oval form. In *Philonthus æneus* about one hundred such small pits occur irregularly on the terminal joints; besides, in this species on each side of the terminal joint is an apparatus, which is like the compound pit generally occurring in the Diptera.

Very remarkable pits occur in the antennal lamellæ of *Melolontha vulgaris* and other Lamellicorns. Only on the outer surface of the first and seventh (in the female the sixth) antennal leaf, as also on the edges of the other leaves, arise scattered bristles; on the inner surface of the first and seventh leaves, as also on both surfaces of the second to sixth leaves, are close rows of rather shallow depressions of irregular form, some circular, others regularly hexagonal. Their number is enormous: in the males thirty-nine thousand, in the females about thirty-five thousand, occur on each antenna.

The antennal pits and teeth of *Dytiscus marginalis* are morphologically and physiologically identical with those of bees and wasps. In *Anopthalmus bilimekii* St., Hauser found on the last antennal joints about sixty teeth, which essentially differ in form from those previously described; they are very pale, transparent, cylindrical, elongated, and bent elbow-shaped on the first third, so that the last two-thirds run parallel with the antenna. (Fig. 12.) The length of these remarkable teeth is 0.035 mm., their breadth 0.005 mm. I only found them in Anopthalmus, and in no other species of Carabidæ; they must resemble the teeth described in Chrysopa. Similar teeth occur on the maxillary and labial palpi of beetles. *Dytiscus marginalis* possesses at the end of each terminal palpal joint a group of very small teeth, which were also detected in *Anopthalmus bilimekii*, *Melolontha vulgaris*, etc. In *Carabus violascens* were detected on the maxillary palpi large, plainly microscopical, white disks which are surrounded with a great number of extremely small teeth.

Whether the above-described organs on the palpi of beetles should be considered as olfactory or gustatory in their nature can only be determined by means of physiological experiments; they probably receive taste-nerve terminations.

The Hymenoptera furnished very good material for histological purposes, so that Hauser could not only study the terminal apparatus of the olfactory nerves in the perfect insect, but also in three different stages of the pupa. These are described at length, as regards the distribution of the pits and teeth, in *Vespa crabro;* each joint of the antenna (flagellum) possesses between thirteen hundred and fourteen hundred pits, nearly sixty teeth, and about seventy tactile hairs; on the terminal joint there are more than two hundred teeth, so that each antenna has between thirteen thousand and fourteen thousand olfactory pits and about seven hundred teeth (Kegel). Fig. 6 represents a cross-section through the penultimate antennal joint of *Vespa crabro;* we can see how thick are the series of openings on the surface of the antennæ, and how regular is the distribution of the teeth.

The distribution of the olfactory pits and olfactory teeth is thus seen to be very general; the deviations are so insignificant that there is no reason for the establishment of more than one type.

Antennal pits with a small crevice-like opening occur in genera nearly allied to Vespa and also in most Ichneumonidæ, Braconidæ, and Cynipidæ. But the crevice-like openings in these families are considerably longer and often are of a somewhat twisted shape. In all the species with translucent antennæ we can recognize the inner mouth of the pit as a round or nearly round disk situated usually under the middle of the opening. The antennal pits of *Apis mellifica*, as well as those of Bombus and allied genera, differ from those of the Ichneumonidæ in being not like crevices, but circular openings.

The distribution of the olfactory peg or tooth-like projections (Kegel) seems to be much more limited than that of the pits in the Ichneumonidæ. Hauser could not find any. *Apis mellifica* possesses on each antennal joint only about twenty slender pale teeth, scarcely a third as many as in *Vespa crabro;* on the other hand Formica, of which genus several species were examined, seems to have far more teeth than pits; they are relatively long, pale, transparent and somewhat clavate; they are not unlike those of Chrysopa; on the terminal joint only were these round openings, which led into a bottle-shaped invagination of the integument and contained an olfactory style. In the Tenthredinidæ only teeth and no pits were to be detected. Sirex has on the under side of the nine last joints of each antenna a group of from two hundred to three hundred small teeth, which resemble those of *Vespa crabro;* Lyda has on the terminal joints about one hundred teeth.

The author then discusses these facts from the Darwinian point of view. His views we may present in a subsequent number of this magazine.—*A. S. Packard.*

EXPLANATION OF THE FIGURES.

LETTERING.—*a, a,* circular thickening of the skin surrounding the opening of the olfactory pit; *ax,* thread-like continuation of the nerve-cell; *b,* vesicle-like bottom of the olfactory pit, through which the olfactory style passes; *br,* bristle in Fig. 3, stout, and protecting the olfactory pit; *bs,* bent bristle or seta; *ch,* chitinous integument of the antennæ; *d,* seen in section; *f,* invaginated pit; *fv,* Forel's flask-shaped organ; *fvo,* its opening seen from the surface; *gl,* gland-like mass of cells; *hyc,* hypodermic cells; *i,* entrance into the canal belonging to the pit; *m,* olfactory membrane; *m', m'', mc,* membrane-forming cell; *n,* nerve of special sense; *nc,* nucleus of the sense- or ganglion-cell; *o,* opening into the olfactory pit; *p,* olfactory pit; *cp,* compound pits; *pw,* wall of the pit; *s,* a large seta; *sc,* sense- or ganglion-cell; *st,* olfactory or sense-style, sometimes peg-shaped; *tb,* tactile bristle.

FIG. 1. Olfactory organ of Caloptenus.

FIG. 2. Longitudinal section through the third antennal joint of a fly (*Cyrtoneura stabulans*), showing the compound pits from above and in section.

FIG. 3. Vertical section through a single olfactory pit in the antenna of the horse-fly (*Tabanus bovinus*).

FIG. 4. Antennal pit of *Melolontha vulgaris,* seen in vertical section.

FIG. 5. Section through an olfactory pit of *Vespa crabro.*

FIG. 6. Section through antennal joint of *Vespa crabro,* showing the great number of olfactory pits, the olfactory and tactile bristles.

FIG. 7. Olfactory pits of the antenna of *Melolontha vulgaris.*

FIG. 8. Olfactory pits of the antenna of Stenobothrus.

FIG. 9. Olfactory pits of the antenna of *Vespa vulgaris.*

FIG. 10. Olfactory pits of the antenna of Formica.

FIG. 11. Olfactory pits of the antenna of Bombus. FIGS. 7–11, after Kraepelin.

FIG. 12. Organ of smell of Anophthalmus. After Hauser.

ZOOLOGY.

Notes on the Larger Florida Planorbes.—Having occasion lately to examine a number of Planorbes from Florida, I noticed that considerable confusion exists in the names various collectors give the species. I give below notes on all the species I have received from the State.

Planorbis trivolvis Say.

P. bicarinatus Say. Northern Florida. Stearns has recorded this species from several Pacific coast localities. I found it abundant and typical in Southern Texas. It has, thus, a range nearly as extensive as the *P. trivolvis.*

P. tumidus Pfr. is not an uncommon species in the peninsula, though hitherto overlooked, probably confused with *glabratus* or *trivolvis.* This shell is quite distinct from all other Florida species. Several rather immature specimens, apparently the same, have been sent me from Wacama Lake, N. C.

P. glabratus Say. *P. duryi,* var. *intercalaris,* approaches this species in some characters. From the other known Planorbes, *glabratus* is quite distinct. Distribution probably the same as *P. tumidus,* but decidedly local, according to the information given by my correspondents.

P. duryi Wetherby is a form widely spread and apparently

PLATE XV.

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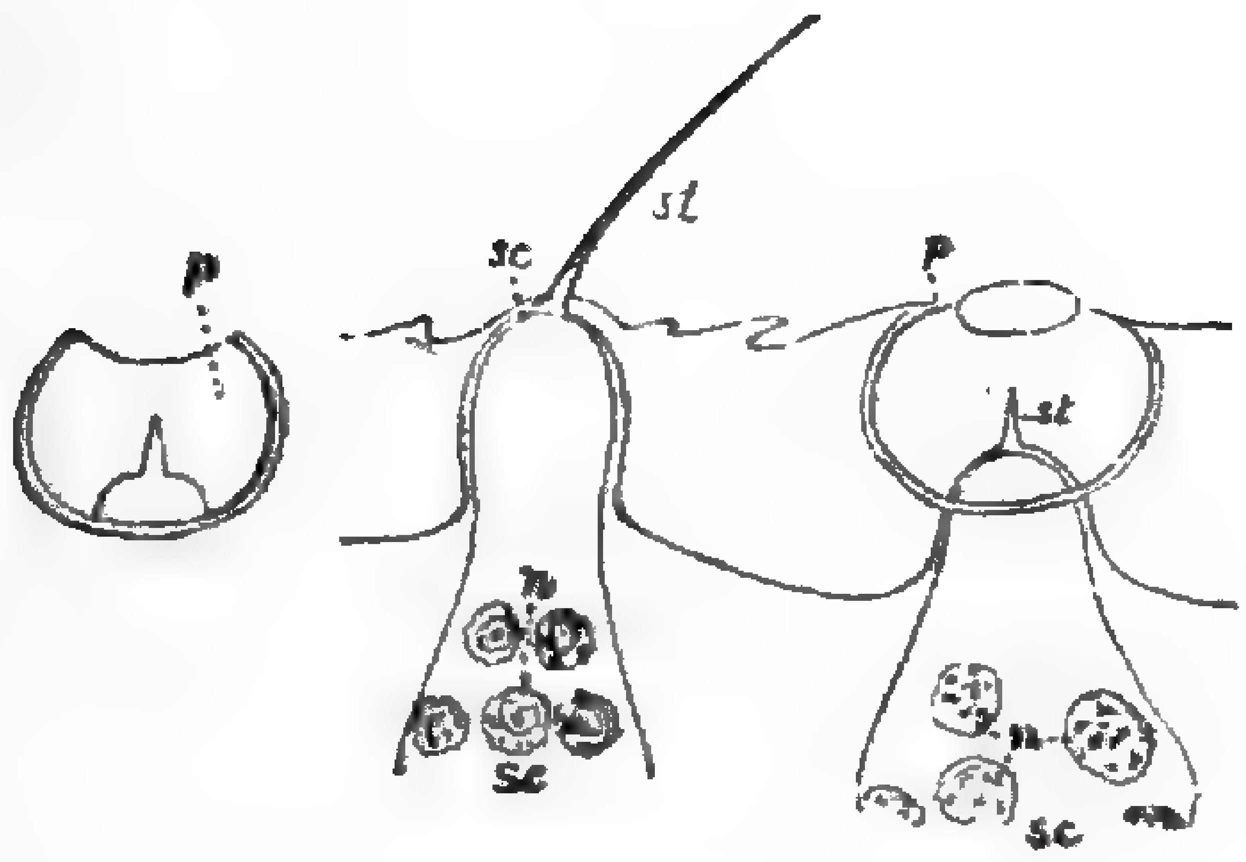

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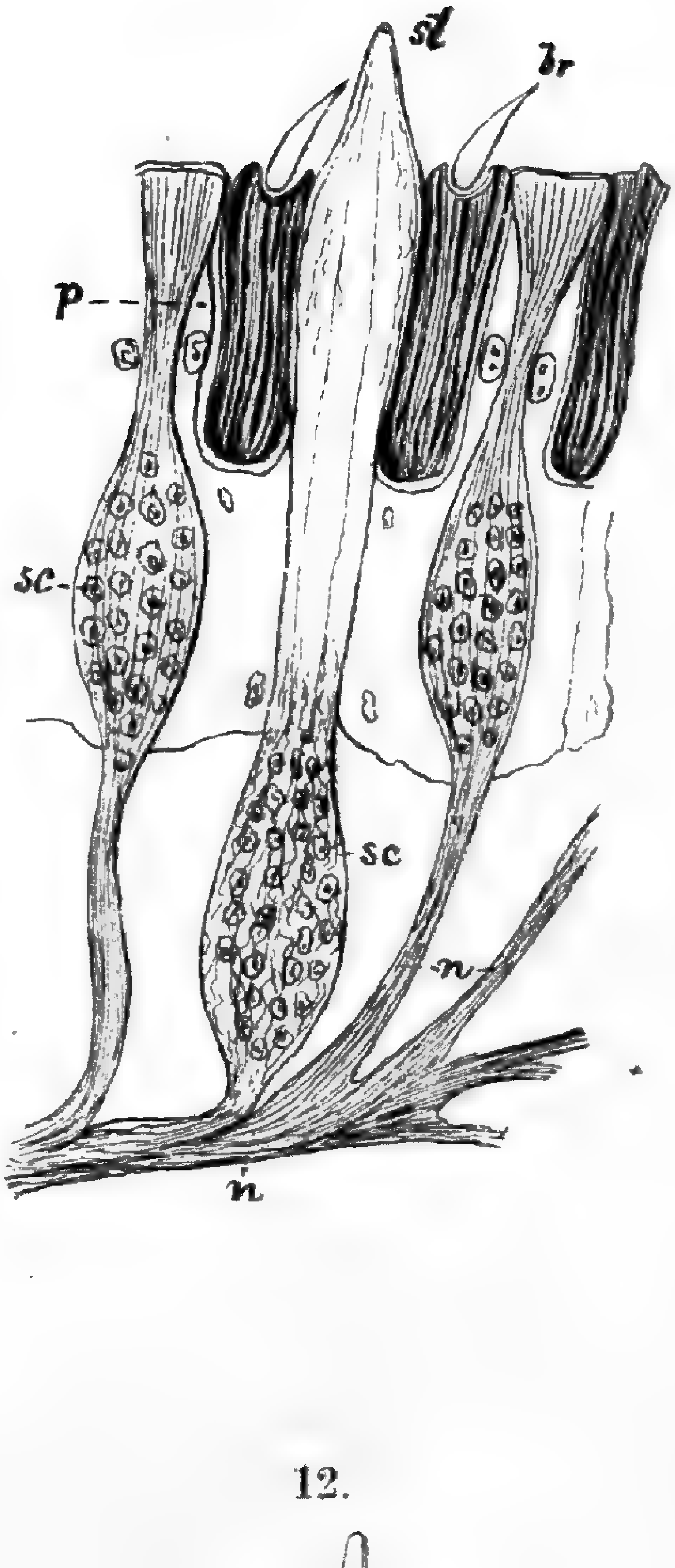

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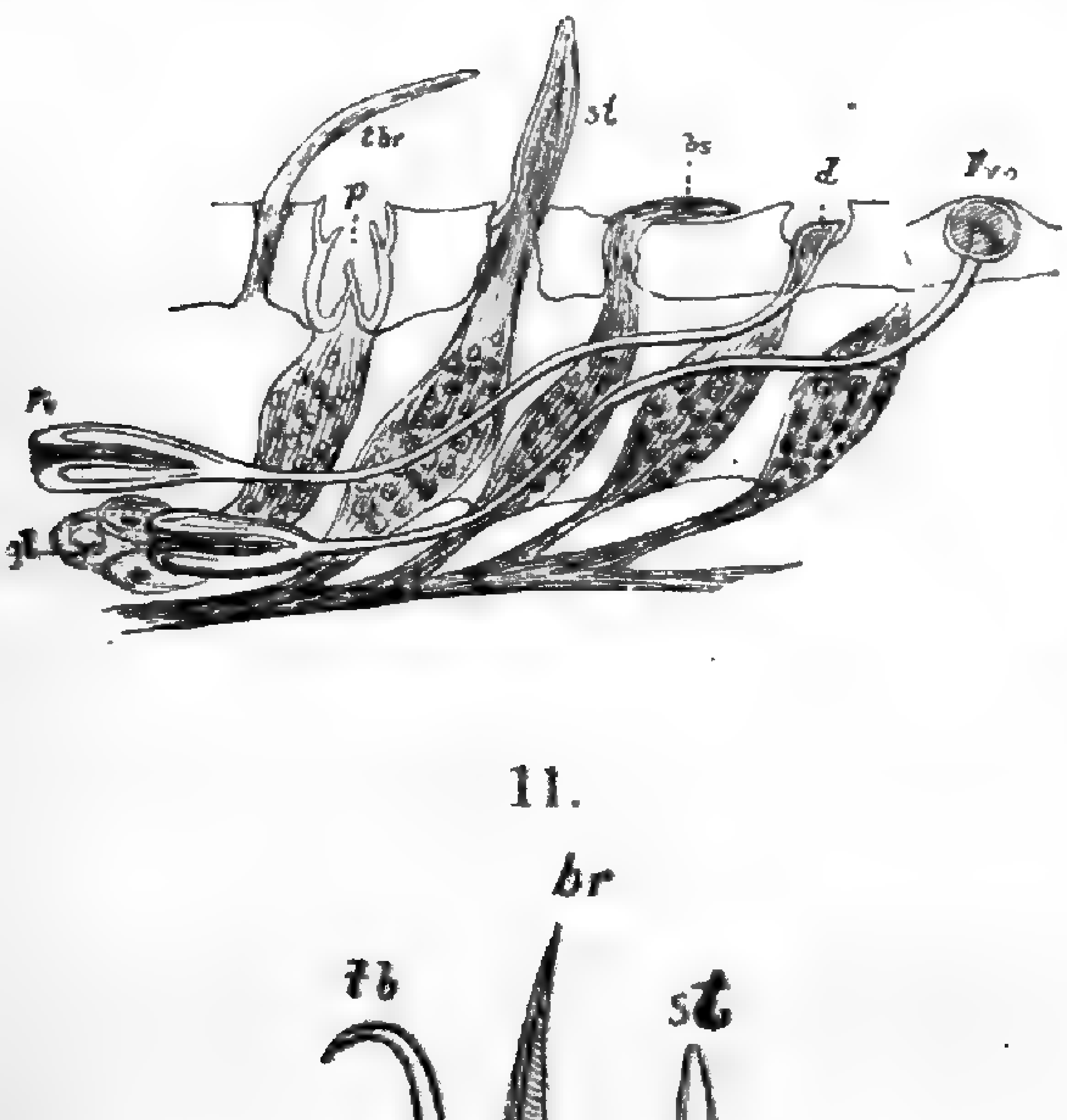

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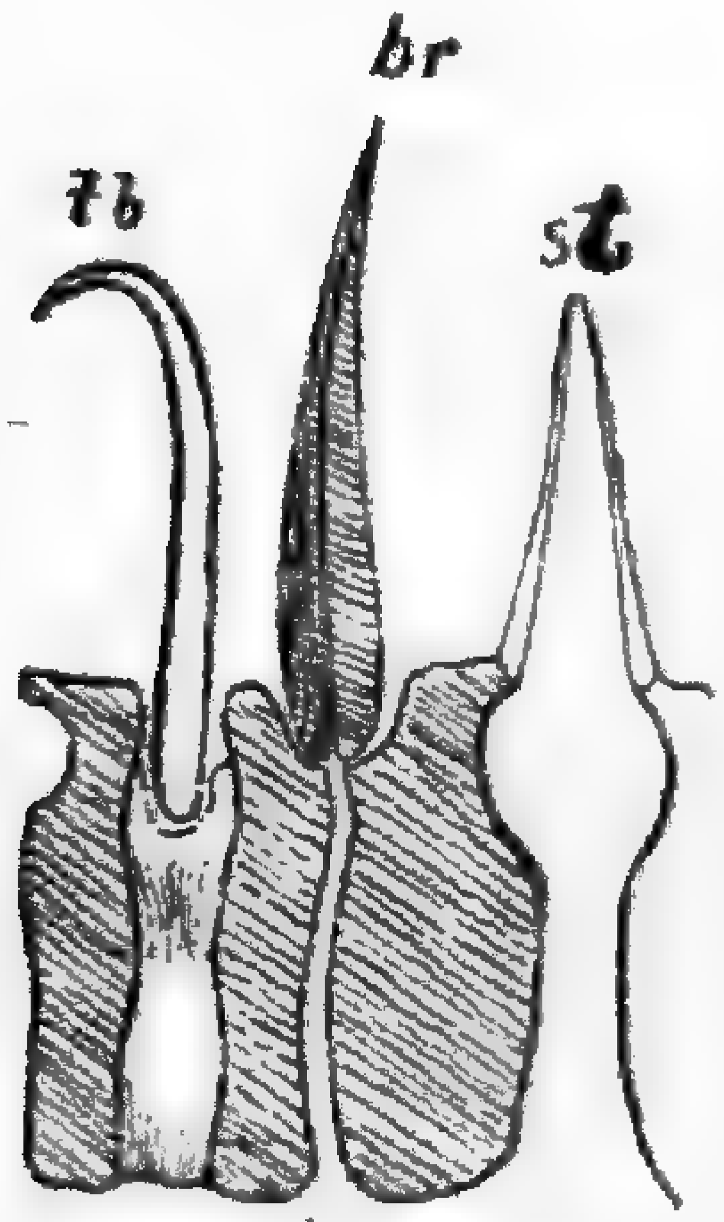


12.

ORGANS OF SMELL IN INSECTS.

abundant in the peninsula, but usually *not* rightly named in cabinets. It varies greatly in form from typical *duryi*, which is four-whorled, carinated above to the aperture, and has only a fraction over one whorl visible on base, to a flatter, more discoidal form which I have called var. *intercalaris*, showing over three whorls of base, and with the outer whorl rounded above, much as in *glabratus* Say. Other specimens have the whorl ascending at aperture, and, as Say would put it, "labrum horizontally subrectilinear." This form is usually marked "*lentus* Say" in collections, sometimes "*corpulentus* Say," but the solidity, polished surface, etc., at once separate *duryi* in all its varieties from these shells and from *trivolvis* Say. Somewhat malleated specimens are also found, and the uptilting of inner whorls mentioned in Wetherby's description is a not uncommon variation in the typical form. This species is allied on one hand to *glabratus* Say, and in other characters approaches

P. scalaris Jay,—a snail which is placed in a different genus by nearly every author who mentions it. After figuring in Paludina, in Physa, and in the exotic genus Ameria, it may finally be located in the Helisoma[1] section of Planorbis, wtth all the foregoing species. Although the resemblance of *P. scalaris* to the *young* of normal Planorbis is quite marked, it is probably not in any true sense a case of persistence of embryonic characters. Its derivation from some such discoidal species as the *P. duryi* is more likely.—*Harry A. Pilsbry.*

Is Littorina litorea Introduced or Indigenous?—In regard to the question as to whether *Littorina litorea* is introduced or indigenous, Dr. Dawson has informed the writer of the article on this subject in the AMERICAN NATURALIST for November, that he collected the shell at Pictou, N.S., as far back as 1840, and probably earlier. Dr. Dawson says, further, that *L. litorea* "is and has long been widely distributed in Northumberland Strait and its vicinity, and that specimens authenticating this may be found in my collections in the Peter Redpath Museum of McGill University." Dr. Dawson believes, from its wide distribution so far back, that "it is a regular and probably aboriginal member of the fauna of Acadia."

It is with great diffidence that the writer ventures to disagree with so thorough a student of these matters as Dr. Dawson. But he is unable to see that anything is proven by this new addition to our knowledge of the distribution of the shell, except that it existed upon our shores earlier and more widely spread than

[1] Helisoma naturally includes not only such species as *bicarinatus* Say and *lordi* Bd., but all the large American species which have the inner whorls of spire sharply carinated above, whether the aperture be rounded or angular in the adult. All the species placed in the typical section of Planorbis in Land and Fresh-Water Shells, Pt. II., except *havanensis* and *liebmanni*, which I have elsewhere shown to belong in Segmentina, and Subcrenatus Cpr., belong in the section Helisoma.

we supposed. We cannot perceive that it affects the evidence tending to show that it has been introduced.—*W. F. Ganong.*

Development of Alpheus.—Mr. F. H. Herrick contributes to No. 54 of the Circulars of Johns Hopkins University an account of his researches on the development of several species of the shrimp Alpheus. There is a small cup-shaped gastrula, and the early rudiments of the embryo have a V-shaped outline, the base of the V being formed by the rudimentary abdomen. The three nauplius appendages appear nearly simultaneously, and the upper lip grows out between the first and second antennæ. The later history of the eyes is traced, but the optic invagination described by Reichenbach in Astacus and Kingsley in Crangon was not noticed.

Deep-Sea Isopoda.—In the *Transactions of the Zoological Society* (vol. xii. pp. 77–141, pls. 16–27, 1886) the Rev. A. M. Norman and the Rev. T. R. R. Stibbing enumerate and describe the deep-sea Isopoda of the families Apseudidæ, Tanaidæ, and Anthuridæ, which have been taken by the recent English dredging expeditions in the "Lightning," "Valorous," and "Porcupine." In all, twenty-six species are enumerated, of which seventeen are new. Several new genera are characterized: Sphyrapus, Tanælla, Alaotanais, Cyathura, Anthelura, Hyssura, and Calathura. Several changes are introduced in the names of the North American forms. *Leptochelia algicola* Harger is regarded as synonymous with *L. savignyi* Kroyer and *L. dubia* Kr. *Anthura brunnea* Harger and *A. polita* Stm. are referred to *Cyathura carinata* (Kr.). *Anthura brachiata* Stm. is made the type of the new genus Calathura. Under the general account of the family Tanaidæ are some very interesting remarks on the existence of two forms of males in this group.

Molluscs of Lake Tanganyka.—Pelseneer gives a list of twenty-five species of terrestrial and fluviatile molluscs brought back from the neighborhood of Lake Tanganyka by Captain Stormes. Among the most interesting points made out are the anatomy of the genus Pliodon, which throws light on the relationship of this mollusc, the affinities of which were uncertain before. He finds that it is distinguished from the Unionidæ by two posterior orifices, a rather long pallial sinus separating the branchial and pedal orifices; the mantle cavity is completely divided into anal and branchial chambers by the branchiæ; and by the shapes of the labial palpi. The affinities are rather with Mutela, Spatha, Triquetra, and other members of the family Mutelidæ of H. and A. Adams. The terrestrial molluscan fauna of the region is not specially interesting, but that of the fresh-waters has been characterized as "marine" in its facies. This aspect Pelseneer does not recognize.

Echinoderm Morphology.—Ph. H. Carpenter, the able English student of the living Crinoids, has recently published two papers on the morphology of the Crinoids, in review of the account of *Antedon rosacea* given by Vogt and Yung in their "Traité d'Anatomie Comparée Pratique." In one (*Annals and Magazine Natural History*, January, 1887) he reviews almost every point made by the authors, and points out many sins of omission and commission. The second paper is in the *Quarterly Journal of Microscopical Science* for the same month, and deals with what Vogt and Yung regard as symbiotic algæ, but which have been previously called sacculi. He shows by their structure, relationship to different species of Comatula, their development, and other points, that they cannot be algæ, and thinks that their nature is still as obscure as it was before the publication of the "Traité Pratique" was published.

Nettle-Cells.—R. von Lendenfeld has a paper on the function of the nettle-cells of Cœlenterata in the January number of the *Quarterly Journal of Microscopical Science.* Nettle-cells are defensive structures situated in the ectoderm, and usually also in the endoderm, of all Polypomedusæ. Their structure is some-

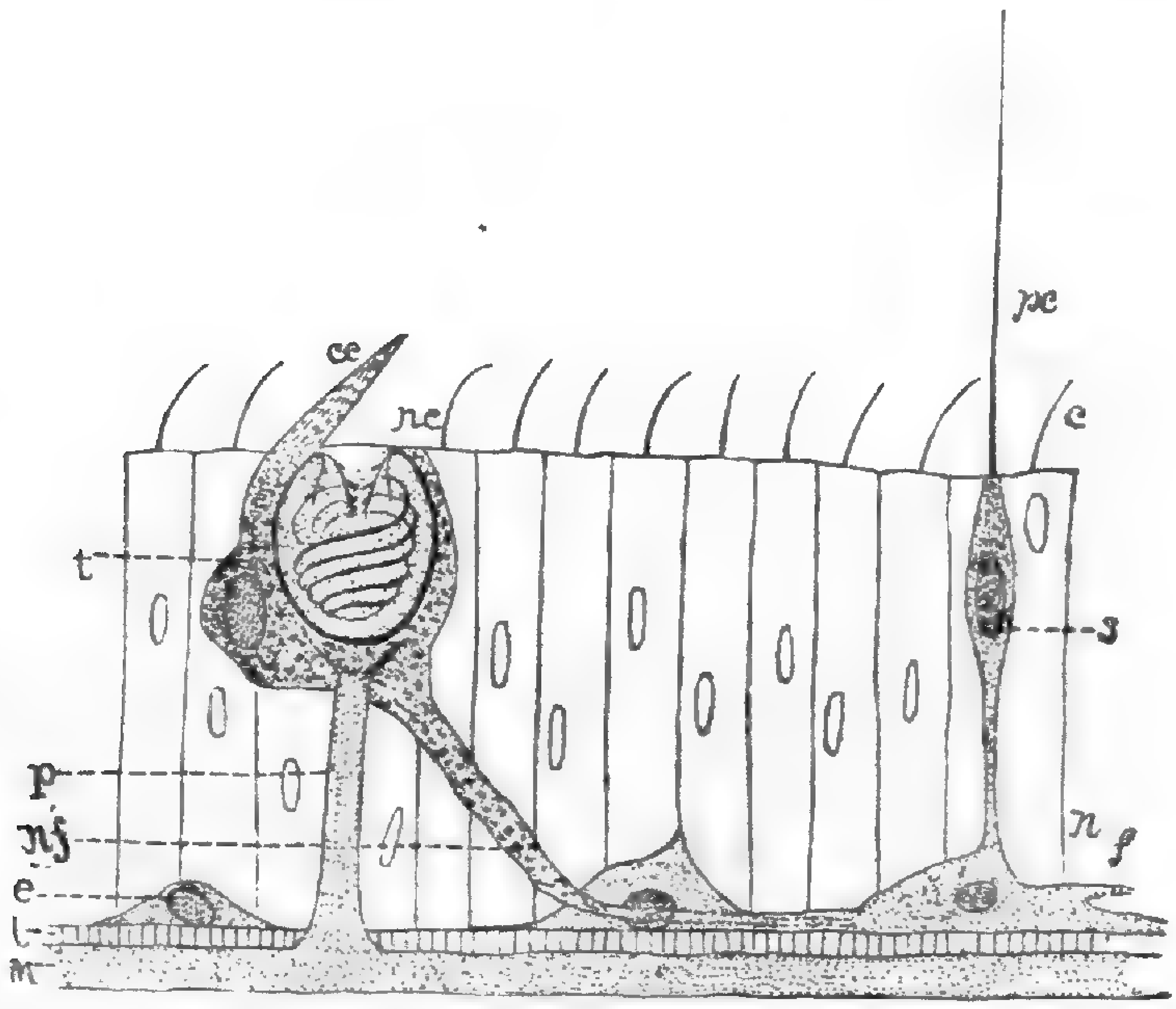


Diagram of a nettle-cell with the surrounding nucleated columnar epithelium: *c*, cilia; *ce*, cnidocil; *e*, sub-epithelial muscle-cell; *f*, tangential nerve-fibre; *l*, longitudinal striated muscles; *m*, mesodermal supporting lamella; *n*, ganglion-cell; *nf*, nerve connecting ganglion-cell with *ne*, nettle-cell; *p*, peduncle of Hamann; *pc*, palpocil connected with *s*, sense-cell; *t*, thread coiled up inside of nettle-cell.—After Lendenfield.

what complicated. They consist each of a single cell hollowed within to contain a long spirally coiled thread, and produced at the surface into a strong process,—the cnidocil,—which projects in the direction from which foreign objects are most likely to reach the organism. Under proper stimulus the nettle-cell contracts, forcing out the contained thread, which becomes turned inside out during the operation, as one may invert the finger of a glove. It is this thread—or rather multitudes of them, each charged with poison—which produces the well-known nettling effects of many jelly-fishes. The thread is forced out with great force, and penetrates soft bodies, bearing the poison with it. The question is, What is the physiology of the contraction? Lendenfeld reviews the previously existing ideas and shows their weak points. His own view is that the action of these structures is to some extent voluntary and under control of the ganglion-cells. The contraction of the peduncle of Hamann withdraws the nettle-cell below the surface under certain circumstances. Contraction of the nettle-cell itself and the forcing out of the thread is reflex; the cnidocil is the sensory organ, and on the application of stimulus to this the act takes place. The granular peduncle first described by Lendenfeld is regarded as the nerve-fibre connecting the nettle-cell with the nervous system of the animal. Von Lendenfeld's figure, reproduced here, will elucidate the structures concerned.

Some Rare Indiana Birds.—The present winter in Indiana has been remarkable for the occurrence in this State of several species of birds which are not often seen here. The rarest of these is perhaps the Evening Grosbeak (*Hesperiphona vespertina*). On Saturday, January 22, Mr. Charles H. Bollman saw and shot a single specimen of this rare bird on the campus of the State University at Bloomington. On the same day, Mr. Cal. Meridith and a companion, at Frankfort, one hundred and twenty-five miles north of Bloomington, saw a flock of twelve, from which they secured five. I learn that one or more specimens were seen about the same time in Lake County by members of the Ridgway Ornithological Club, who were enjoying a sleigh-ride in that part of Indiana. A few days later two other specimens were seen in the vicinity of Frankfort. This is, I believe, the first record of the occurrence of the Evening Grosbeak in Indiana.

From all parts of the State come reports of captures of Snowy Owls. I hear of three at Lebanon, three at Valparaiso, six at Indianapolis, one at Greencastle, two at Martinsville, one at Sullivan, and two each at Columbus and Greensburg. These no doubt represent not more than one-half of the number actually taken in the State. They were most abundant in November, and none have been reported since the 1st of January. Short-eared Owls have also been reported much more common than usual, and Bald and Golden Eagles have been taken with unwonted frequency.

In this connection it is proper to record the occurrence of the

Florida Snake-Bird (*Plotus anhinga*) in this State. According to Mr. Fletcher M. Noe, of Indianapolis, a fine male, in full plumage, was taken on the West Fork of White River, two miles south of Indianapolis, on August 25, 1886. A month later Mr. Noe received a specimen of the Western Grebe (*Æchmorphus occidentalis*), which was killed near the same place.—*B. W. Evermann, Indiana State Normal School*, February 14, 1887.

Zoological News.—Birds.—At the recent Scientific Congress at Paris, M. de Montessus read a memoir upon the present state of ornithological science in Paris. Among other facts he mentioned the capture of *Synoicus lodoisiæ*, an Australian gallinaceous bird, in the Department of Sâone-et-Loire. Previously a specimen had been killed in Lombardy, and these are the only specimens known to have been taken in Europe, but are sufficent to cause the enumeration of the species among the casual visitors to that country.

Worms.—Mr. James E. Benedict describes one new genus and five new species of tubicolous Annelids in the "Proceedings U. S. Nat. Museum for 1886." All of them are from the warmer waters of America, and were collected by the Fish Commission steamer "Albatross."

Mollusca.—Paul Pelseneer, in the "Bulletin Sci. Dépt. Nord," II., vol. ix. (reprinted in the *Annals and Magazine of Natural History* for January, 1887), gives a review of the Gymnosomatous Pteropods. He recognizes only six genera, arranged in four families among the previously described species, but describes a new genus and species, *Notobranchæa mcdonaldi*, from off the coast of the Carolinas. Only a single specimen is known, which is in the United States National Museum. The foot-notes appended to the reprint of the article add considerably to the value of the paper.

Echinoderms.—Rev. J. G. Swan calls attention, in the *Bulletin of the United States Fish Commission*, to the abundance of Holothurians in the region of Queen Charlotte Islands and in Alaska, and suggests that it may prove profitable to collect and cure them into trepang for the Chinese market. In China they command a price of about forty or fifty dollars a ton, and their preparation is not very difficult.

Sponges.—At a recent meeting of the Zoological Society of London, Dr. R. von Lendenfeld read a paper on the classification of sponges and their systematic position. His extensive investigations in the rich sponge fauna of Australia, as well as on the collections of the "Challenger" expedition, have given him facilities rarely excelled. He proposed an arrangement in which forty-six families were described and the principal genera enumerated. His paper also contained a tolerably complete bibliography of the subject, the size of which is shown by the fact that it embraced the titles of fourteen hundred and forty-six papers. The systematic position of the sponges was also discussed.

EMBRYOLOGY.[1]

Haddon's Introduction to the Study of Embryology.[2]—This new work, now in press, is apparently designed to give the student a comprehensive outline of the science of embryology in a moderate compass, with such illustrations as will enable him to appreciate the fundamental similarity of many of the stages of the embryos of the different classes and orders of the Metazoa as represented by specific forms. A manual of this sort has been very much needed for the class-room. The monumental treatise of Balfour, in two volumes, already needs revision, so fruitful have been the labors of active embryological workers within the last five years, or since its completion. That activity itself has been very largely due to the stimulus given to ontogenetic research by that singularly endowed genius, lost to us before he had had time to develop the germs of the great generalizations and suggestions which are so lavishly strewn through the pages of his great work. Balfour's large work, also, is not adapted to the purpose of a class-room manual, and can only be used as a book of reference or as a guide to the advanced student. In the first volume, and the early part of the second, the groups are treated of separately and not directly and comparatively, so that it is not well adapted to serve as a text-book for the laboratory in elementary work. Other elementary text-books use only extremely modified forms, such as the chick and the mammal, as types; other lower groups being scarcely alluded to. This tends to develop a bias in the mind of the student which it is hard for him to shake off, and in extending the range of his studies he finds himself almost unwittingly trying to attempt to apply his knowledge of the development of the higher forms to that of the lower, with the result that he becomes confused in making his comparisons. To overcome this difficulty we need an elementary work which will contrast the higher and lower types at once, and in such a way as will lead the student to at once see the agreements and differences in the methods of development of different types. It is especially important to show what a profound influence the presence of a larger and larger amount of yelk has had in modifying gastrulation; how the types of cleavage have been apparently modified from the same cause,

[1] Edited by Dr. John A. Ryder, Philadelphia.

[2] An Introduction to the Study of Embryology, by Alfred C. Haddon, M.A., Professor in the Royal College of Science, Dublin. London, 1887.

and so on. These and kindred questions will evidently be fairly dealt with in Professor Haddon's treatise, judging from the advanced sheets of the first forty pages of the work, which the editor of this department has had the opportunity of examining. The work will evidently be up to date, and many points upon which the earlier authors were uncertain will be cleared up. The newer views as to the origin of the middle germinal layer will be presented, and Duval's discoveries in the development of the chick will receive the attention they deserve. The more recent discoveries in mammalian embryology and the discussion of karyokinesis, so far as it relates to embryology, will also find a place. On the whole, it may be said that this work is a timely one, which will be welcomed by all who are alive to the significance of the great issues of the embryological science of the future. The author and publisher are also to be congratulated upon the many new figures introduced,—many of them original,—and the excellent typographical appearance of the pages. The style of the author is clear and terse, a matter that is not always as well attended to by the authors of elementary text-books as is desirable, in spite of the remarkable precedents before them in the clearly-written elementary manuals by such writers as Huxley, Clifford, and Tyndall.

Development of Mysis.—Nusbaum gives (*Biol. Centralblatt*, vi. 663) a preliminary account of his observations on the development of Mysis. According to him the egg is surrounded by a blastema, and has the nucleus lying at the formative pole. The result of the first segmentation is to form two cells, one of which forms the blastoderm while the other sinks into the yelk. The larger central cells of the blastoderm later divide and give rise to cells which sink beneath the blastoderm, and together with the product of the first segmentation just mentioned are called "Vitellophags." After this process the rudiments of the embryo appear,—a caudal area from which extend forward the ventral bands, which diverge like a V and terminate in the oval cephalic lobes. Now, according to Nusbaum, a shallow invagination takes place in the caudal area, and the invaginated cells undergoing a rapid proliferation form a solid entoderm. Behind this point the abdomen now grows out. The mesoderm, says Nusbaum, arises as two bands from the ventral bands. The vitellophags at first lie just beneath the germinal area, but later they sink deeper into the yelk, and as their name implies they feed upon the yelk. Nusbaum has some comparisons with the development of various hexapods, which he thinks are similar in the formation of the germinal layers, and his vitellophags he compares to similar cells in Scorpio and Oniscus, as well as to the phagocytes of Metschnikoff. He also describes a dorsal organ which appears at first as a paired ectodermal thickening, the halves of which eventually unite on the dorsal median line. Of its function or meaning he expresses no opinion, but thinks it is the same as the dorsal organ well known in Tetradecapods.

While we must wait for the publication of the final paper—promised in the *Archives de Zool. Experimentale*—before expressing definite conclusions as to the accuracy of Mr. Nusbaum's interpretations, it would appear as though he had fallen into several errors. First, his vitellophags are apparently ento-mesoderm, and their formation is the gastrulation. Second, the gastrulation described by Nusbaum can be reconciled with the formation of the ventral flexure, and his mesoderm, as shown by his figure, is clearly the early stage of the nervous system. Looked upon in this way, Nusbaum's account is reconcilable with what is known of the development of other Crustacea; in any other way it is unintelligible. Nusbaum, it may be said in passing, is not the first one who has mistaken the ventral flexure for an invagination. —*J. S. K.*

Development of Spiders.—Morin gives (*Biol. Centralblatt*, vi. 658) an account of the development of Theridion, together with notes on that of Pholcus, Drassus, and Lycosa. The nucleus lies at the centre of the egg, and not until the third segmentation (eight cells) does the yelk segment. From this point the segmentation of the yelk pyramids accompanies that of the nucleus, through the stages of 16, 32, 64, etc., until the 128-cell stage is reached. Morin saw no polynuclear pyramids. At the 128-cell stage the nuclei and the surrounding protoplasm have reached the surface and form the blastoderm. They then separate from the pyramids, and the yelk then forms a homogeneous unnucleated mass. The blastoderm now becomes thicker on the ventral surface, and from its centre cells are budded inwards, some of which remain between the parent cells and the yelk, while others sink into the yelk itself. The germ now consists of all three layers. Morin does not regard the primitive cumulus as of such importance in the formation of the germ layers. In his experience it does not appear until after they are formed; indeed, he could not find it in any stage in Theridion. In Pholcus it was formed chiefly of mesoderm-cells, the ultimate fate of which was to form blood-corpuscles. In other points of the early development he agrees well with Locy (see this journal, xx. p. 676). The germinal area now becomes divided into segments, and then the appendages appear, first the four pairs of walking-legs, next the maxillæ, and then the mandibles; the abdomen has but four pairs of rudimentary appendages. At the same time the appendages appear the body cavity begins to form. The heart is formed much as in annelids, and as described by Kowalevsky and Schulgin in the scorpion. Its cavity is a remnant of the segmentation cavity. Now the splanchnopleure becomes thrown into a series of folds (Balfour's septæ) in the abdominal region, dividing the yelk into a series of lobes, the rudiments of the liver.[1] The proctodæum and stomodæum offer nothing for note. The mesenteron does not begin to take definite shape until a day or two before hatching. Then the entoderm-cells which are scattered through the yelk gather at the inner ends of the fore and hind guts, and later unite in the middle. A similar process gives rise to the liver epithelium. This process is not completed at hatching, and for some time the young spider takes no food, the yelk remaining serving for food. The lungs arise as ectodermal invaginations at the base of the first pair of abdominal appendages, these becoming converted into their outer covering. The second pair of abdominal appendages disappear, the third and fourth are converted into the spinnerets, the spinning glands arising as ectodermal invaginations into their walls. —*J. S. K.*

PSYCHOLOGY.

The Seat of Consciousness.—M. Steiner, of Heidelberg, presented to the Academy of Science of Berlin, on January 7, 1887, a memoir on the consciousness of the cerebral hemispheres in fishes. The author, who has published a similar paper on the Batrachia, comes to the following conclusions:

1. In the fishes voluntary movements, and the ability to feed spontaneously (proving the existence of both reflex and direct sensations) *persist* after the removal of the hemispheres.

2. In Batrachia these functions are bound to the hemispheres, excepting vision, which remains after their removal.

3. In birds vision is also located in the hemispheres, but not cutaneous sensation.

4. In the Mammalia, finally, the cutaneous sensations also are located in the hemispheres.

The author therefore concludes that in the Vertebrata the functions of the middle brain emigrate little by little into the hemispheres as they develop; or, rather, that the evolution of hemispheres depends on a successive accumulation of functions which at first belong to the middle brain.—*A. Herzen in Revue Scientifique*, No. 9, 1887.

Remarkable Intelligence of a Rat.—As throwing light upon the question of the intelligence of the animal creation, in the exhibition of memory and reasoning power, beyond the mere pale of recognized instinct, I wish to give the readers of the American Naturalist a brief account of an interesting incident of which I was witness. On a very warm day in early summer I happened to be standing near a chicken-coop in a back yard when I noticed the head of a very gray and grizzled rat thrust

[1] Compare Limulus.—*Ed. Nat.*

from a neighboring rat-hole, and concluded to watch the movements of the veteran. After a careful survey of the surroundings, our old rodent seemed to be satisfied that all was right and made a cautious exit from the home retreat. A fresh pan of water had been recently placed before the chicken-coop for the use of Mother "Chick" and her interesting brood. These all seemed to have satisfied their thirst, and the water looked a friendly invitation to the thirsty old rat, which immediately started towards it. The rat had not reached the pan before five half-grown young ones rushed ahead and tried to be first at the water. The old rat thereupon immediately made a leap like a kangaroo, and was at the edge of the dish in advance of the foremost of her litter. Then ensued a most remarkable occurrence. The mother rat raised herself on her haunches and bit and scratched her offspring so severely, whenever they attempted to reach the water, that they all finally scudded away, evidently very much astonished and frightened at the strange and unaccountable behavior of their mother. I was as much astonished as they, and awaited with renewed interest the outcome of this remarkable performance. When the little ones were at a safe distance, the reason for her extraordinary behavior began to be revealed at once in the intelligent actions of the old mother rat. She first wet her whiskers in the water, looked suspiciously about her, then very cautiously and carefully took a dainty little sip of the liquid. She tasted it as tentatively and critically as a professional tea-taster, and when she was satisfied that it contained no poisonous or other deleterious matter, she gave a couple of squeaks, which quickly brought her young and thirsty brood to her side, and all fearlessly drank to their fill. Now, this old mother rat was experienced, had evidently learned her lesson in that school thoroughly, and so she would not allow her young and untaught litter to taste water which might have contained *rat poison*, or what not, until she had satisfied herself that the liquid was harmless. As I witnessed this little scene in lowly animal life the thought would keep coming, Does not this look very like reason?—*J. Croll Baum*, 630 *N. Broad St., Phila., Pa.*

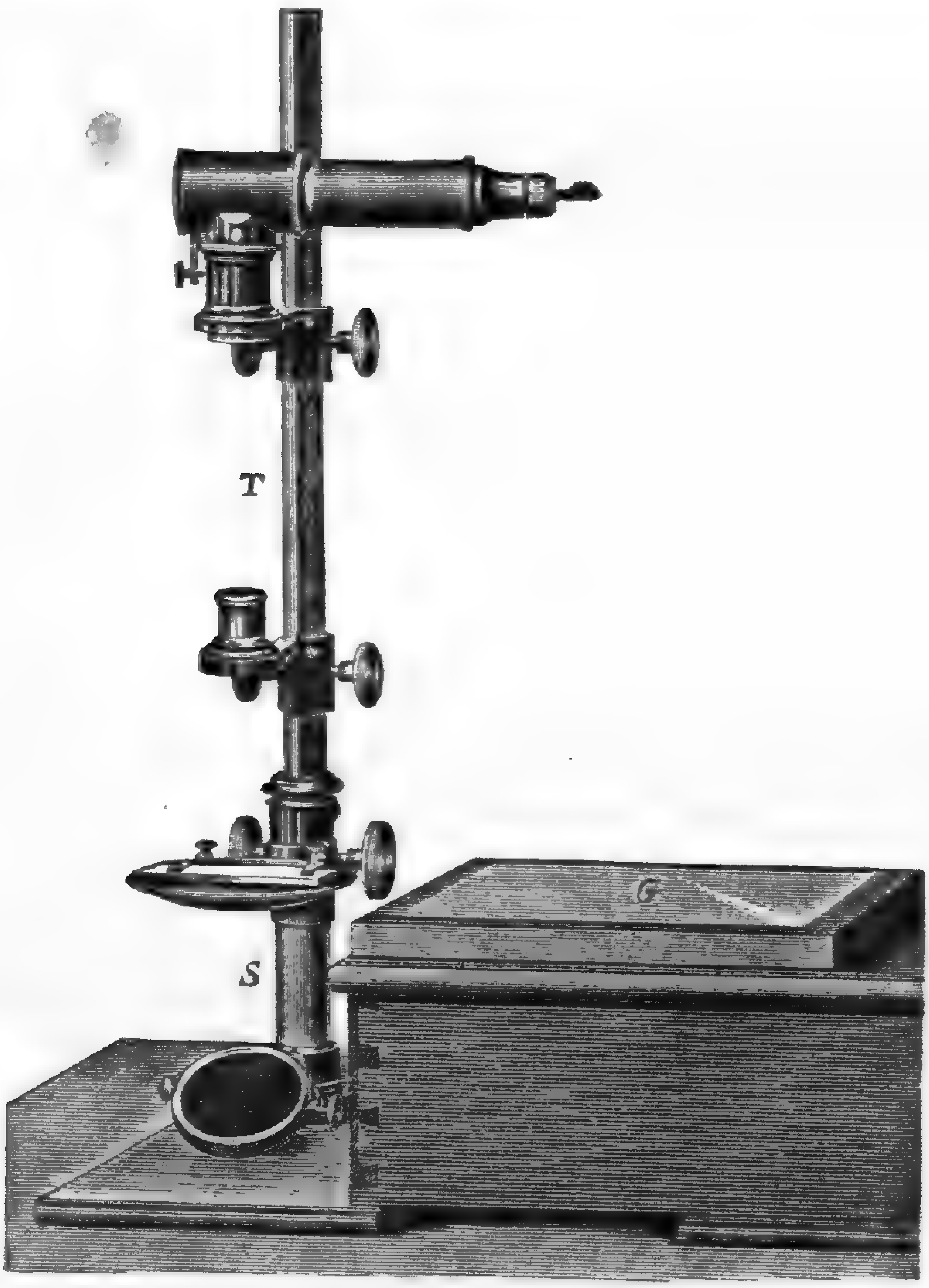
Ants and Sunflowers.—While riding out, one day in July last, over the prairies north of Kirwin, Phillips County, Kansas, my attention was attracted by a number of ant-hills surrounded by sunflowers. A closer examination showed that the hills were inhabited by a large red ant, one-half to three-quarters of an inch long. Their hills were only two or three inches high and from one to two feet in diameter, but for a radius of two to four feet around each hill every particle of vegetation was cleared off, and around the outside of this cleared space grew a single row of sunflowers, affording considerable shade to the circular court within.

The prairie was unbroken where these hills were seen, though cultivated fields were not far distant. Query, Where did the ants get their sunflower seed?

There were three other gentlemen with me who observed and commented on this curious circumstance.—*Erving L. Richardson.*

MICROSCOPY.[1]

The Embryoscope.—The embryoscope devised by Hartnack[2] represents an improved form of the drawing apparatus introduced by Professor His.[3] The magnifying power of this instrument may be made to vary at pleasure from *four to seventy* diameters, thus offering the same facilities for making exact contour drawings with low powers that the microscope affords with higher powers.



For this wide range of magnification only two objectives are used. The height of the rod bearing the mirror, the object-table, the objective, and the camera lucida, is about 40 cm. The glass

[1] Edited by C. O. WHITMAN, Ph.D., Milwaukee, Wisconsin.
[2] Zeitschrift für Instrumentenkunde, Sept. 1881, p. 284.
[3] Anatomie menschlicher Embryonen, Leipzig, 1880, p. 8.

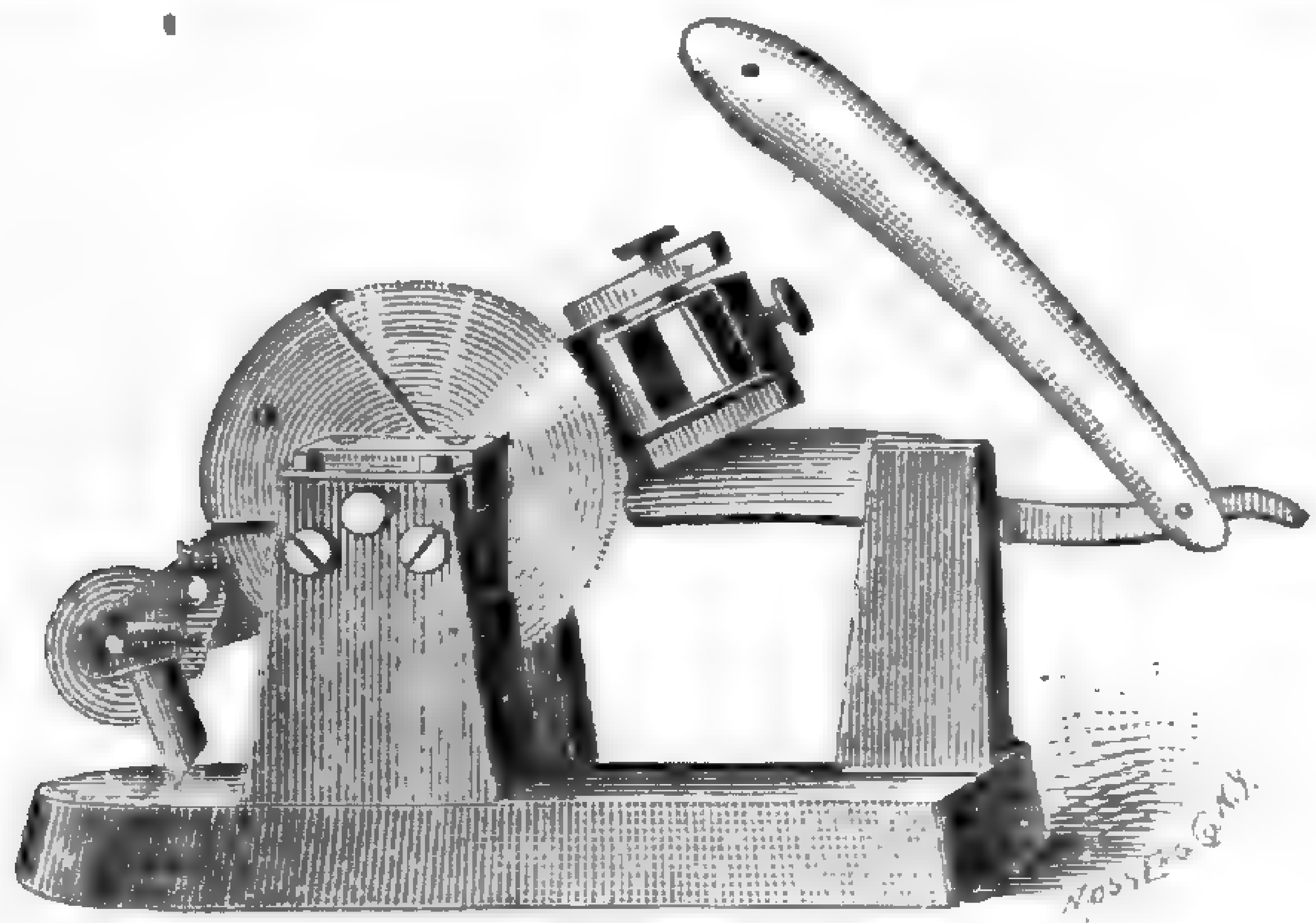
plate, *G*, resting on the étui, serves as a drawing surface. All parts of the apraratus can be packed in an étui measuring 38 cm. × 22.5 cm. × 9.5 cm.

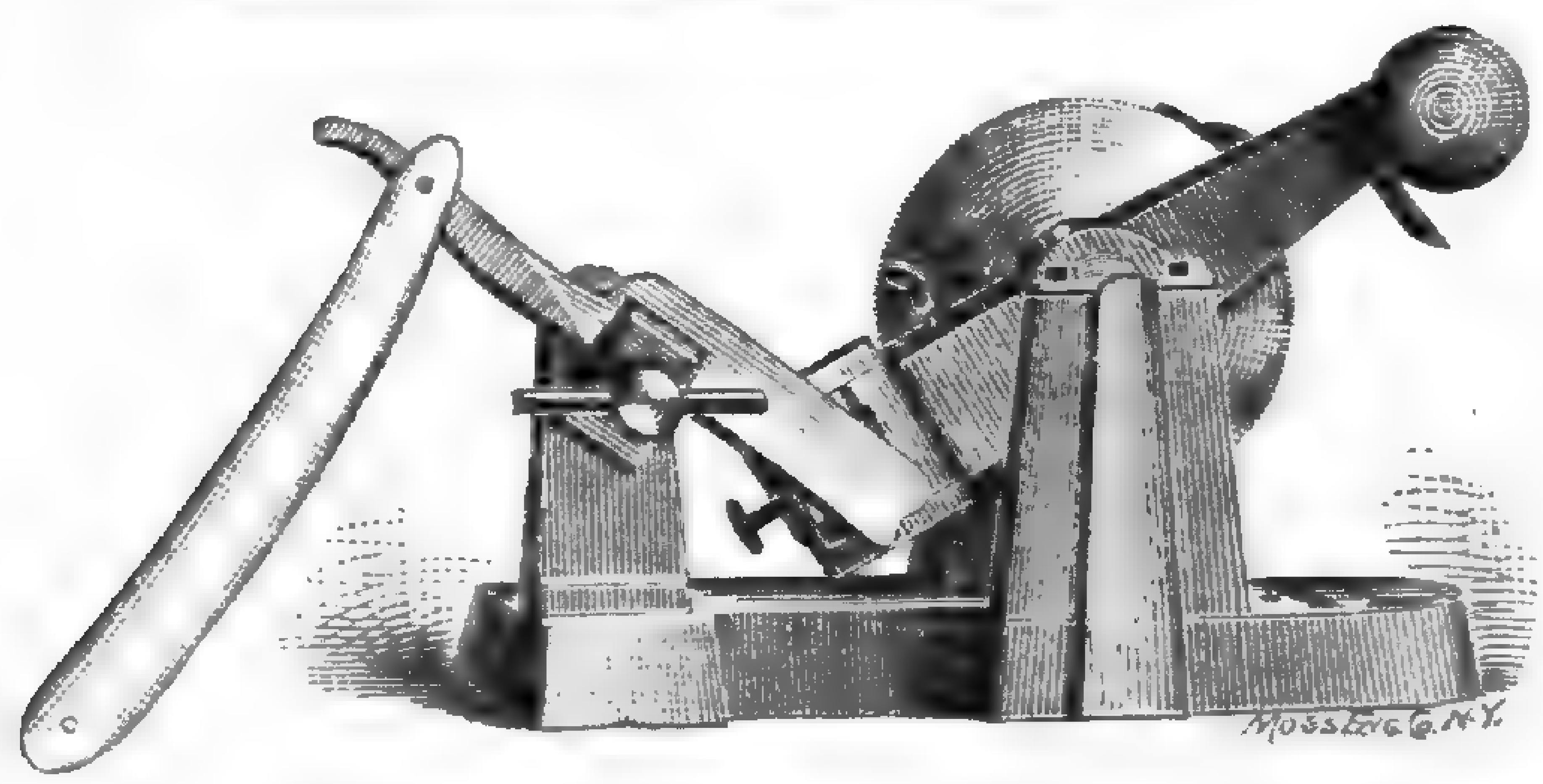
The magnifying power varies according to the relative positions given to the object-table, objective, and camera. The determination of these positions for different magnifications should be made before using the instrument. For this purpose a millimetre scale may be placed on the object-table, and the camera and objective moved until the picture projected on the drawing surface has the desired enlargement. The following table, showing the positions for given magnifications, was prepared by His. The numbers will vary somewhat for different eyes, hence the necessity of preparing one's own table.

	Magnification.	Upper edge of Object-carrier. mm.	Upper edge of Camera-carrier. mm.	Diameter of field of vision. mm.
Objective 0	4	235	265	32
	5	216	247	25
	8	115	193	20
	10	100	218	15
	15	83	240	11
Objective 1	15	13	65	—
	20	12	88	—
	25	11	112	8.5
	30	11	133	—
	40	11	170	—
	50	10	200	—
	60	10	230	3
	70	10	260	—

The lower objective is screwed into the upper, and the higher objective into the lower side of the carrier. For a magnification of four diameters it is necessary to place the object-table 20 mm. below its upper limit. In order to avail one's self of the whole field of vision with an enlargement of only four or five diameters, it is necessary to unscrew the object-table from its ring, and to use the latter alone as table. Having placed the objective and the camera in the positions required for a given magnification, the focal adjustment is effected by moving the object-table.

Ryder's Automatic Microtome.—This new instrument has been devised by Professor John A. Ryder, of the Biological Department of the University of Pennsylvania, in order to facilitate the preparation of sections for large classes, and also for the rapid preparation of series of sections in ribbons in embryological work, in which the element of time becomes a serious consideration. The device is small and compact and is also automatic,—that is, the same movement which cuts the section also brings the block into position for cutting the next successive section, and so on continuously, of any desired uniform thickness; the cutting takes place as fast as it is possible to move a vibrating lever up and down through a distance of three inches with the right hand. Nearly all other automatic microtomes are costly, unwieldy, large and heavy, or else very complicated and liable to get out of order. The only exception in part to this rule is the Rocking Microtome, made in Cambridge, England; but it cuts in an arc, so that the sections are segments of a hollow cylinder, and not parts of a perfect plane; besides, the rocking or vibrating arm admits of only a very limited movement, so that the instrument is suitable only for cutting sections of objects of very limited dimensions; nor is the position of the block adjustable. Moreover, in none of the automatic microtomes now in use is it possible to place the knife at right angles or any other desired angle to the direc-





tion in which the block to be cut is moved,—a great desideratum in botanical or other work in which an inclined knife is necessary. In order to supply an instrument serviceable especially to teachers, as well as to all classes of students, botanists, pathologists, histologists, and zoologists, the designer has attempted to bring together all the desirable features of previously invented instruments, in as simple, convenient, and compact a form as possible, without sacrificing rapidity and efficiency of action.

The working parts are an oscillating lever, which is provided with a clamp at one end into which the paraffine-holders are adjusted, and at the other with a simple handle. This lever rests upon trunnions on either side, and these in turn rest in triangular notches at the top of the two pillars between which the lever oscillates. At the cutting end of the lever a spring pulls the lever down and effects the sectioning and also the adjustment for the next section. The lever is pushed over and adjusted for the successive sections by a hollow screw, through which passes the trunnion on the side away from the knife. This screw is fixed to a toothed wheel, three inches in diameter, which revolves close by the side of the oscillating lever. The toothed wheel and screw is actuated by a pawl fixed to the side of the lever near the handle. The number of teeth which this pawl can pass in a single vibration downward is controlled by a fixed stop screwed into the under side of the oscillating lever near the handle; the end of this stop striking on the top of the bed-plate thus brings the lever to rest at a constant point in its downward excursion. An adjustable sector by the side of the toothed wheel throws the pawl out of gear after a given radius of the wheel has been turned through an arc embracing the desired number of teeth. This adjustment is also effected before the block, containing the object to be cut, reaches the edge of the knife. The adjustment for the next section is therefore effected while the surface of the block is not in contact with the under side of the knife, so that no flattening or scraping effect is produced on the surface of the block in its upward passage past the knife.

The movement of the vibrating lever being arrested at each down stroke at one point and the pawl which catches into the notches in the toothed wheel being released at any desired point by the action of the adjustable sector, it is possible to adjust the apparatus with great accuracy for cutting sections of any desired thickness. If a given radius of the wheel is moved through the arc embraced by a single tooth, sections are cut having a thickness of only $\frac{1}{10000}$ of an inch, or .0025 mm.,—a thickness which is only practically possible with paraffine embedding and a very keen razor. If more teeth are taken by the pawl, any thickness of section is possible up to about $\frac{1}{400}$ of an inch, or .0625 mm.[1]

A freezing attachment which has lately been appended to the apparatus shows that frozen sections can be made with as great rapidity and success as those cut from objects embedded in the paraffine block, and very nearly, if not quite, as thin. The freezing attachment is as simple and efficient as the self-adjusting and cutting devices of the instrument. Other auxiliary apparatus makes it possible to cut celloidin sections. This is effected by means of alcohol conducted by a tube from a reservoir to the knife, over which the fluid will run and drain into a tray below in such a way as not to come in contact with any other parts of the machine. This tray fits into a recess in the side of the bed-

[1] The screw which adjusts the block for cutting has exactly fifty threads to the inch, and there are two hundred teeth on the periphery of the toothed wheel. The value of a single tooth is, therefore, $\frac{1}{50} \times \frac{1}{200} = \frac{1}{10000}$ inch.

plate of the instrument just below the knife, and into this tray the celloidin sections may be allowed to drop as fast as cut.

The paraffine-holders are square and seven-eighths of an inch in diameter, so that a block of that size may very readily be sectioned. For the botanist, one of these holders is provided with a movable side and screw for clamping objects, so that rather tough stems may be firmly held between blocks of cork, while the more delicate vegetable tissues, or such as must be embedded in fresh carrot, soaked in gum and hardened in alcohol, may also be firmly held for sectioning by the same device, provided the pieces of carrot are first trimmed into the right shape. The same style of holder is equally applicable for holding the corks—if properly trimmed—upon which tissues are embedded in celloidin or in gum. This style of holder also enables one to embed very long objects entire in paraffine,—such as earth-worms,—and to cut them as a single piece, provided the surrounding paraffine is carefully trimmed so as to have two opposite sides parallel. An object six inches long and three-fourths of an inch in diameter embedded in this way may be cut into an absolutely continuous series of sections without losing any essential portions. This is accomplished by slipping the block through the quadrangular clamp for the distance of half an inch every time a half-inch of the object has been cut off in the form of sections. One-half inch is the length of block which can be cut at one time without readjusting the feed-screw which moves the block and vibrating lever over towards the knife, the whole being kept firmly in place against the face of the hollow screw by a strong spring which presses against the end of the trunnion on the outside of the iron pillar on that side of the instrument where the knife is fastened, so that all the sections are of exactly the same thickness from first to last. Cutting up large objects in the manner above described is not possible with any other form of microtome yet constructed.

Almost any section-knife—wide- or narrow-bladed—will fit into and be firmly held by the knife-clamp, which is, however, intended more especially to hold an ordinary razor. The best razors for cutting sections have been found to be those of the best make only, such as Wade & Butcher, or Joseph Rodgers & Sons, of Sheffield. Only such razors as hold an edge well should be used.

For ribbon-cutting by the paraffine method the block containing the object, after it is trimmed and soldered to the paraffine with which the holder is filled, by means of a heated wire, is covered with a thin coat of soft paraffine or "paraffine-gum," and of which "chewing-gum"[1] is made. This enables one to cut

[1] Chewing-gum may be rendered available for this purpose if it is melted at a temperature somewhat above boiling, when the sugar which it contains will separate as caramel, leaving the pure paraffine-gum, which may be drained off and used as

ribbons of any desired length, since the softer paraffine at the edges of the successive sections sticks them together by their margins as fast as they are cut.

The ribbons may be allowed to fall upon a slip of paper, which may be drawn out, as fast as the sections are cut, from under the bed-plate of the instrument, beneath which there is a space left for this purpose between the three toes or tripod upon which whole apparatus rests. The edge of the knife also remains in the same plane, no matter at what angle the cutting edge is placed with reference to the direction in which the block to be cut is moved, just as in the best forms of the sledge microtome.

The advantages which this new instrument offers are, briefly, comparatively small cost, great efficiency, rapidity, and accuracy. One hundred sections per minute may very readily be cut with it. Its simplicity of construction, with few wearing parts, and slight liability to get out of order in the hands of inexperienced persons, will also commend it to the teacher and investigator. Experience has already shown that those once using it can scarcely ever be again induced to use the most efficient sledge or automatic microtomes of different design if they can have access to this instrument. This device is made by Mr. Zentmayer, whose name is a sufficient guarantee of the workmanship employed in its construction.

SCIENTIFIC NEWS.

—William Willoughby Cole, the Earl of Enniskillen, who died November 12, 1886, was the possessor of one of the largest collections of fossil fishes in existence. He was associated with Sir Philip Grey Egerton in preparing the catalogue of fossil fishes so useful to geologists.

—Henry Woodward, of the British Museum, is preparing a third edition of Morris's "Catalogue of British Fossils," to be issued by the Cambridge University Press this year.

—C. E. Broome, an English mycologist, died at Bath, England, November 15, 1886.

—Karl Goebel, professor of botany at Rostock, is called to Marburg to take the chair left vacant by the death of Professor Wigand.

—Culver Hall, at Dartmouth College, caught fire, Sunday, February 20, and the geological and zoological collections of the college had a narrow escape from destruction.

directed, if the manipulator should find it difficult to get the paraffine-gum of commerce.

—Dr. Martin Websky, professor of mineralogy in the University of Berlin, died November 27, 1886, aged sixty-two years.

—Thomas H. Dodge has given the Worcester Lyceum and Natural History Association one thousand dollars to buy tents and build a pavilion for the summer classes managed by the association at Lake Quinsigamond.

—Dr. R. W. Shufeldt has issued a catalogue of his various scientific papers and shorter notes. It embraces one hundred and three titles of articles already published, besides several more in press or well under way.

—Professor Ernst Haeckel, of Jena, goes this year to the Mediterranean to continue his studies.

—The lectures given by Sir J. W. Dawson during the past winter, before the Lowell Institute, in Boston, are to become the basis of a volume in the "International Scientific Series." The subject is the development of plants in geological time.

—January 15 Professor Hermann Burmeister, the entomologist and palæontologist, completed his eightieth year. Since 1871 he has been settled in Buenos Ayres, and has done much towards the working up of the fauna of the Pampas formations. The University of Buenos Ayres has recently conferred upon him, as well as upon Carl Berg, professor of botany and zoology in the University, the degree of Doctor of Physical Sciences, in recognition of their labors.

—R. Friedländer and Sohn, of Berlin, have begun the publication of another help for students of natural history. It is entitled *Societatum Litteræ*, and aims to give, in the briefest shape, a catalogue of all articles relating to natural sciences published in the transactions of learned societies in all parts of the world. The first number contains eight pages, and indexes thirty journals. The numbers will appear monthly, and are sent post-free for the nominal sum of two and one-half marks. It is edited by Dr. Ernst Huth, of Frankfurt a. O. From its more limited field, it will not take the place of the well-known bibliographic lists in the *Zoologischer Anzeiger*.

—Mr. Alexander Agassiz was honored with the degree of Doctor of Science by the University of Cambridge during his recent visit to England.

—There were fifty-two different contributors to the first volume of the American Naturalist, twenty years ago. Of these at least thirty-four are alive at the time of writing. Are scientific studies conducive to longevity?

—Thomas Moore, the superintendent of the Botanic Gardens at Chelsea, London, died on the first day of this year. He was well known among botanists.

—L. Ranvier, the well-known histologist of Paris, has been elected a member of the Academy of Sciences in the place of Charles Robin.

—F. L. Cornet, who has been a special student of the Cretaceous and Tertiary formations of Belgium, died at Mons on the 20th of January, aged fifty-two years.

—Dr. K. Oebbecke, of Munich, is called to the chair of Mineralogy and Geology at the University of Erlangen.

—In the recent death of Professor Edward L. Youmans science has lost a most untiring advocate and disseminator. The value of such men to the intellectual life of a country cannot be estimated. As editor of the *Popular Science Monthly Magazine* Professor Youmans brought before the American public in popular form the latest results of the scientific work of Europe, besides giving currency to much interesting matter which lies on the borderlands of science, and in the field of applied science and of art. Professor Youmans was born in Albany County, New York, in circumstances which required energetic effort to enable him to gratify his natural taste for knowledge. During his life he was harassed by a disease of the eyes, which also rendered his labors more difficult. But in spite of these obstacles his success in his chosen field of instructor and disseminator of positive knowledge, was probably greater than that of any other American.

—We much regret to have to notice the suspension of the German scientific periodical, *Kosmos*, a high-class journal conducted with much ability.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—March 2.—Mr. C. D. Walcott described a trip to the Grand Cañon of Colorado (illustrated by the stereopticon), and Mr. J. H. Emerton showed parts of a restoration of a skeleton of Uintatherium and described the method of making paper models.

New York Academy of Sciences.—January 17.—The following paper was read: "On an Iron Meteorite that fell at Mazapil, Mexico, during the display of 'Bielid' meteors, November 27, 1885, with an account of its fall by Professor José A. y Bonilla, Director of the Zacatecas Observatory" (with exhibition of the specimen), by Mr. Wm. Earl Hidden.

January 10.—The regular business meeting was held, and the question of raising the annual dues to ten dollars was discussed. The following paper was read: "Notes on the Growth of a Vinegar-plant in Fermented Grape-juice" (with specimens), by Dr. N. L. Britton.

Monday evening, March 7.—H. L. Fairchild addressed the academy upon "Transformations of the Skin in the Animal Kingdom."

Biological Society of Washington.—March 5.—The following communications were made: P. L. Jouy, "Corea: the Country and the People." Prof. Frank Baker, "Notes on some Unusual Muscular Variations." Dr. T. H. Bean, "European and American Work in Deep-Sea Ichthyology." Dr. C. Hart Merriam, "Contributions to North American Mammalogy. Description of New Species of *Evotomys*." Dr. H. G. Beyer, "Remarks on the Preservation of Bottled Museum Specimens."

Appalachian Mountain Club.—Tuesday evening, March 1.—Mr. C. D. Walcott, Assistant U. S. Geological Survey, presented a paper entitled "A Trip to the Grand Cañon of the Colorado," illustrated by the stereopticon.

Kent Scientific Institute of Grand Rapids, Kent County, Michigan.—The following are the officers for 1887: President, E. S. Holmes; Vice-President, W. A. Greeson; Secretary, C. A. Whittemore; Treasurer, S. L. Fuller; Corresponding Secretary, E. S. Holmes; Director of Museum, W. A. Greeson; Curator, E. L. Moseley; Librarian, E. L. Moseley.

Sedalia Natural History Society.—November 8, 1886.—Professor G. C. Broadhead, formerly State Geologist of Missouri, read a paper on the "Geology of Western Missouri."

December 13.—Mr. H. M. Specking spoke on the "Study of Natural History and the Use of the Microscope."

January 10, 1887.—F. A. Sampson exhibited a fine skull of the *Coryphodon* from the Bad Lands of Dakota, and described it; Mrs. C. Demuth read a paper on "Reptiles." The following were elected officers for 1887: President, Dr. J. W. Trader; Vice-President, H. C. Sinnett; Corresponding Secretary, F. A. Sampson; Recording Secretary, J. W. Walker.

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ON OVIPOSITION AND NURSING IN THE BATRACHIAN GENUS DENDROBATES.

BY HERBERT H. SMITH.

IN 1875, while at Santarem, on the Lower Amazon, my attention was called to a brown frog which was very common in the damp forests of the highland, hopping about under the trees. I frequently saw it several miles from any stream or pool. The hunters told me that this frog carried its young on its back. I offered a high price to any one who would bring me a specimen with its young, but no one took advantage of my offer; and though I was collecting every day in the woods where the frog was so common, I never saw the young at all. I finally concluded that my informants had confounded this species with the Surinam toad, which is probably found at Santarem, though I never saw it there; so I dismissed the subject from my mind. My specimens of the frog were lost, with other batrachians and reptiles, on the voyage to New York, but I hope to determine the species with fresh examples at some future time.

One day in October or November, 1884, I was camping in a lonely spot forty miles northeast of Cuyabá, in Western Brazil; the place was on the *chapadão*, or table-land, close to a deep, rocky ravine. All around were little tracts of damp meadow, such as are frequently seen even on the higher portions of the *chapadão*. Brazilians call such spots *varzeas*, a name also applied to the grass-lands on river-plains, to which these patches have only a superficial resemblance. The *varzeas* of the highland always lie above a layer of hard rock, on which water accumulates in the rainy season, soaking the thin layer of loam and turf which covers it. At such times there may be half a dozen little streams flowing through a spot of *varzea* over smooth rocks, where the subsoil has been washed away; but in the long dry season, from May to October, the water evaporates, the ground dries up and cracks, the grass on it withers, and generally the streams disappear. The plants and animals of the *varzeas* are different from those of the rest of the table-land, the species being adapted to endure these periodical changes. The place that I am speaking of is quite dry during four or five months of every year, and even the ravine at its side has no water; at that time the nearest stream is several miles away.

Wandering over the meadow, now sodden with a recent rain, I observed a small frog of a kind which I had frequently seen on the *varzeas.* Some peculiarity in its appearance made me examine it more attentively, when, to my astonishment, I saw that its back was covered with little black bodies, set close together like paving-stones on a street, if I may compare small with large; the entire upper surface of the frog, except the head, was concealed by them. I very quickly saw that these were tadpoles, so crowded in the small space that the tails and part of the bodies were hidden. They were moist and glistening, as if they had just been taken from water, though the sun was shining hotly over them. If my observation was correct, they were kept in place by a viscid secretion, either from their own bodies or from that of the parent. They moved slightly while I was watching them.

Up to this time the frog, with its little colony, had remained quite still, so that I had a good opportunity to examine it; but when I attempted to secure it, it hopped into a patch of grass, where, despite of all my searching, I could not find it. I judge that it entered some hole among the grass-roots. Heartily appreciating the fact that a frog in the hand is worth two in the bush, I was obliged to content myself with an entry in my note-book of what I had seen and a resolve to observe the species more carefully in future.

I frequently saw the frog after this, but could never get it with its young. Nearly a year after, my assistant, Mr. W. C. Smith, found a specimen with its colony of tadpoles on a *varzea* very similar to that I have described and in the same region; this he secured, and it is now in the possession of Professor E. D. Cope. Mr. Smith writes me: "Four of the young, I believe, dropped off and were lost; being in a hurry, I threw the frog at once into a bottle of alcohol, and I did not observe how the young were attached to the back."

These very imperfect observations are all that I can give concerning the habits of this very singular batrachian, but I hope that they may serve to direct the attention of other naturalists to these species. The Santarem frog mentioned above was similar in form to this one, though a good deal larger, and very likely it belongs to the same genus. In view of my observations on the *chapadão* species it seems probable that the information given by the hunters was correct, and that the Amazonian frog also carries its young on its back.

In both cases there seems to be an evident adaptation of the habits to the surroundings. The Santarem forests are always moist and comparatively cool, but the absence of standing or running water in those parts where the frog is seen would prevent the ordinary disposition of its young. The *varzeas*, on the contrary, are wet and even partly flooded after rains; but even in the height of the rainy season the pools and streams may dry up if a few days pass without showers. If the young frogs were left in the water they would run the risk of being destroyed before their development was completed. In the dry season the frog, like most other animals, disappears from the *varzeas;* probably it retires to some crevice where it can remain sheltered until the rains set in again. Both the frogs observed with young were seen at the beginning of the rainy season.

It would be interesting to know how the young (or eggs) are first placed on the back of the parent and how they are nourished.

I may notice here that the bright spots on the legs of this frog and of other species serve in a very curious way to conceal the animals. They are only visible when the frog is hopping, and their sudden disappearance when the animal comes to rest causes one to lose sight of it altogether; for the eye naturally follows the bright colors, and perhaps they have the effect of momentarily dazzling it, so that the sombre general surface of the frog, very like the ground on which it sits, becomes for an instant invisible, just as a small dark object becomes almost invisible immediately after gazing at a scarlet cloth or a candle. I have noticed similar effects produced by color-spots in certain insects, especially the butterflies, which are often vividly colored on the inner surface of the wings, so that they are extremely conspicuous when flying; but as soon as the insect comes to rest these colors disappear, and the plain outer surface of the wings is, by contrast, momentarily invisible.

NOTE BY E. D. COPE.—Examination of the specimens collected by Mr. Smith shows that they belong to a species of the genus Dendrobates, which I have described under the name of *Dendrobates braccatus.*[1] It agrees in most of its characters with *D. trivittatus* Spix., but is very much smaller, not measuring half its linear dimensions. As the specimens are, according to Mr. Smith, adult, they must be regarded as specifically distinct. It is also related to the *D. hahneli* of Boulenger,[2] but differs in the considerably shorter posterior limbs.

Dendrobates braccatus Fitzinger. Views from side and below. Copied from Steindachner. (None of my specimens have so much black below.—E. D. C.)

The singular manner in which this species carries its larvæ constitutes a method of nursing distinct from any of those enumerated by Mr. Boulenger in his table in the *Annals and Magazine of Natural History for* 1886, of which I give a copy, inserting the Dendrobates:

I. The ovum is small and the larva leaves it in a comparatively early embryonic condition.

A. The ova are laid in the water.

Probably the majority of Batrachians; all European forms except Alytes.

B. The ova are deposited out of the water.

a. In holes on the banks of pools, which become filled with water after heavy rain, thus liberating the larvæ.

Leptodactylus ocellatus, L.; *L. mystacinus* Burm.; *Paludicola gracilis* Blgr.

b. On leaves above the water, the larvæ dropping down when leaving the egg.

Chiromantis rufescens Gthr.; *Phyllomedusa jheringii* Blgr.

II. The yolk-sac is very large, and the young undergoes the whole or part of the metamorphosis within the egg; at any rate the larva does not assume an independent existence until after the loss of the external gills.

[1] Proceedings Amer. Philosoph. Soc., 1887, April.

[2] Proceed. Zool. Soc. London, 1883, p. 636, Pl. LVII., Fig. 4.

A. The ova are deposited in damp situations or on leaves, and the embryo leaves the egg in the perfect air-breathing form.

Rana opisthodon Blgr.; *Hylodes martinicensis* D. & B.

B. The ova are carried on the parent.

a. By the male.

α. Round the legs; the young leaves the egg in the tadpole state.

Alytes.

β. In a gular (the vocal) sac; the young is expelled in the perfect state.

Rhinoderma.

b. By the female.

α. Attached to the belly.

Rhacophorus reticulatus Gthr.

β. Attached to the back;

aa. The young completes its metamorphosis within the egg.

Pipa.

bb. The free tadpole is carried on the parent.

Dendrobates.

γ. In a dorsal pouch.

aa. The young leaves the pouch in the tadpole state.

Nototrema marsupiatum D. & B.

bb. The young leaves the pouch in the perfect state.

Nototrema testudineum Esp.; *Opisthodelphys ovifera* Weinl.

It approaches nearest to the habit of the *Pipa monstrosa*, which also carries the young on the back. But, as is well known, the skin itself and not a gelatinous secretion encloses the eggs in that species and retains the young until the metamorphosis is complete. The Dendrobates, however, furnishes a hint as to the origin of the temporary growth in Pipa.

Several larvæ accompany one of the specimens of this species, which are stated by Mr. Smith to have been adhering to its back when it was taken. They do not resemble those of Pipa, but rather those of Rana or Bufo. The branchial opening is on the left side, and no limbs are developed. The tail is long. The mouth is not peculiar. The decurved lower lip is present, and is furnished with two transverse series of bristle teeth. A single series of the same extends entirely across the superior labial region, above the upper horny jaw. The papillæ are rather long, and extend all round the inferior lip, and for a short distance on each side at the lateral end of the upper lip, the series presenting an entering angle opposite the mouth. This species is described and figured[1] by Steindachner in the *Verhandl. der k. k. zoölog. botan. Ges. in Vienna*, 1864, p. 258, who refers it to the *D. trivittitus* ("*nigerrimus*"), under the impression that the specimens before him are not adult. He states the latter were labelled *Dendrobates braccatus* by Dr. Fitzinger. This name is not adopted by Steindachner.

[1] Plate XIII., Fig. 2.

THE TACONIC QUESTION RESTATED.

BY T. STERRY HUNT.

(Concluded from page 250.)

§ 29. It must be further noted that the term Taconic, unless qualified and limited as Upper Taconic, includes, besides this Cambrian, another and a not less important series of rocks which cannot be brought into parallelism with either Cambrian or Silurian, and is separated from the Upper Taconic by great lithological differences, as well as by stratigraphical relations and by geographical distribution. We have shown that Eaton long ago pointed out the well-marked stratigraphical discordance between the base of the First Graywacke and the Transition Argillite; and it is also to be observed that the Lower Taconic, which consists of this Argillite (called by Emmons the Magnesian Slate, but including a band of roofing-slate), of the Primitive Lime-rock or Stockbridge limestone, and of the Primitive Quartz-rock or Granular Quartzite, is in many places wanting at the base of the First Graywacke. Indeed, it is not recognized by its distinctive characters along the western border of the Atlantic belt anywhere within the province of Quebec or in northern Vermont; where the Upper Taconic rests upon more ancient crystalline hornblendic and chloritic rocks very unlike the Magnesian slate of Emmons, and where, moreover, neither the Primitive Lime-rock nor the Primitive Quartz-rock are known.

That the green sandstones and conglomerates which make the basal beds of the Upper Taconic contain the ruins of these older crystalline rocks, was already noticed by Emmons, and is seen at many points, notably at Pistolet Bay, in Newfoundland, where a great body of these rocks, which were referred to the Sillery division of the Quebec group, rests directly upon a series of hornblendic and chloritic rocks with serpentines. This immediate superposition of the Sillery sandstones to these crystalline schists was explained in Logan's hypothesis by the double assumption that the green sandstone is the uppermost member of the so-called Quebec group and has escaped an imagined alteration, and that the immediately underlying crystalline rocks belong to the Lauzon or middle member of the same group, which has been altered. When, subsequently, Logan traced the great Graywacke belt of Eaton southwestward into Vermont, and along the western base of the Taconic Hills to the Highlands of the Hudson, recognizing its identity with his Quebec group, and finding it, in its southward extension, to rest in many parts on the crystalline limestones of the Lower Taconic (the Primitive Lime-rock), he declared these to be the altered representatives of the Levis or Sparry Lime-rock, made by him the lowest division of the same Quebec group; the Lauzon, according to his hypothesis, while nearly four thousand feet in the vicinity of the city of Quebec, being elsewhere reduced to a very thin layer, or entirely wanting.

§ 30. That the great crystalline series which forms the Lower Taconic of Emmons lies, as maintained by Eaton, beneath the horizon of the First Graywacke, from which it is separated by a stratigraphical discordance, is thus confirmed by Logan, as well as by J. B. Perry, who, in 1867, described the Lower Taconic as consisting of quartzites, marbles, and talcose schists; and, later, by Marcou, who also notes the want of conformity between the Lower and Upper Taconic. That the horizon of the Lower Taconic is in fact below that of the First Graywacke is disputed by no one who has ever studied the region in question, and the only ground on which it can be assigned to a higher horizon is by maintaining the old error of Mather, who conjectured this First Graywacke or Upper Taconic to be newer instead of older than the Trenton limestone,—a mistake now recognized by all who have investigated this Graywacke belt.

We have elsewhere pointed out the grounds on which those who followed the erroneous view of Mather as to the horizon of the First Graywacke regarded the Lower Taconic quartzites and limestones as Trenton or post-Trenton in age. C. B. Adams and W. B. Rogers regarded the Red Sand-rock and its associated limestones near Burlington, Vermont, which are included in the First Graywacke, as of Medina (or Medina and Clinton) age. Following this, Adams maintained, in 1846, that the quartzites and crystalline limestones of the Lower Taconic were but the altered equivalents of this First Graywacke, and Rogers proclaimed, in 1851, that these crystalline limestones are "probably Upper Silurian or Devonian," while Edward Hitchcock, in 1861, conceived that they "may be as recent as the Carboniferous rocks."

The rocks of the same series have elsewhere been assigned to a still higher horizon. The schistose beds, though principally at the summit, are more or less interstratified with the underlying limestones and quartzites of the Lower Taconic, and in many places include besides limonite both magnetite and hematite. Important beds of these latter ores along both borders of the triassic series in Pennsylvania, embracing those of the Warwick and Jones Mines, of Reading, Boyerstown, Dillsburg, and Cornwall, were, by H. D. Rogers, in 1839, referred to the "middle secondary red sandstone" or trias, adjoining them; the peculiar characters of these crystalline schists being supposed to be due to "the metamorphism of the strata." In 1858, however, Rogers correctly referred them to the horizon of what he called the Primal Slates. Lesley, in 1859, while apparently accepting this latter view, refers with approval to those who regard these ores "as of middle secondary and not of primary age;" in accordance with which opinion the ores of Dillsburg are, by Frazer, in 1876, in his Report of the Second Geological Survey of Pennsylvania, described as mesozoic, and by McCreath, in his report for 1881, are also referred to the same horizon.

§ 31. The ground upon which J. D. Dana still defends the original position of Mather as to the horizon of the Lower Taconic crystalline limestones, while at the same time admitting the now unquestioned pre-Trenton and Cambrian age of the Graywacke series, is by supposing that the apparent succession of eastward-dipping strata in certain sections in this region represents their order of deposition, and, consequently, that the crystalline limestones are not below the Graywacke, as taught by Mather, but above it, and are apparently the altered representative of the Sparry Lime-rock. This, notwithstanding the caution of Emmons, he confounds with the Stockbridge or crystalline limestone of the Lower Taconic, and, therefore, from the organic remains, apparently of Ordovician age, found in the Sparry Lime-rock at the summit of the Upper Taconic, assigns the same age to the Lower Taconic limestone.

§ 32. In some parts of the great valley of Pennsylvania the Cambrian Graywacke or Upper Taconic had been removed from the Lower Taconic before the Ordovician age, and now appears only in isolated areas. In like manner, the Ordovician limestones are represented only by small portions of fossiliferous strata resting upon the Lower Taconic, and probably also upon the Graywacke itself. Here also the gray Oneida-Medina sandstone is found in discordant superposition upon the Lower Taconic.

In regions outside of the great valley—to which the First Graywacke was apparently confined—are found many considerable areas of the Lower Taconic rocks, conspicuous among which are those early noticed in the Carolinas and in Georgia. Among these is a long range described and mapped by Maclure in 1817 as a "Transition belt." This is connected at its northern end with the same rocks in the great valley of Pennsylvania, and extends from the Delaware to the Yadkin River, beyond which, after a little interruption, it appears on the Catawba, and forms the King's Mountain belt in North and South Carolina; where these Lower Taconic rocks were described at length by the late Oscar Lieber as the Itacolumitic series. Without now referring to the other areas of these rocks in the Southern States, and to those which in New Jersey, Rhode Island, and Maine are found to the eastward of the great Appalachian valley, we may note the remarkable display of the same rocks at the mouth of the St. John River, in New Brunswick, and their reappearance in the Cobequid Hills, in Londonderry, Nova Scotia. To the westward, they are found on a considerable area in Hastings County, near the northern shore of Lake Ontario, where they were first described by the geological survey of Canada as the Hastings series.

§ 33. These rocks are largely developed around Lake Superior, where they were first recognized in northern Michigan by Houghton, and were described by Emmons in 1844, and again in 1855, as Taconic. They constitute the lower division of the Upper Copper-bearing series of Logan, and as seen on the north shore of the lake by the present writer were described as the Animikie series. These same rocks in northern Michigan have been, by Murray, Credner, and others, confounded with the Huronian, but the rocks of the Menominee district, including great deposits of iron ores and marbles, were, by Irving, in 1883, regarded as identical with the Animikie series, which the present writer, in 1884, referred to the Lower Taconic. These same rocks in northern Michigan were, in 1880, described by Rominger as part of a great system divided in ascending order into a Quartzite group (including a Marble series), an Iron-ore group, and an

Arenaceous Slate group, the rocks of all of which, from the descriptions, and the specimens which I have been permitted to examine, are apparently identical with the Lower Taconic as seen in Pennsylvania and elsewhere. This great system, according to Rominger, rests in some parts upon a gneissic and granitoid series (his Granitic group) and in others upon a great Dioritic group, chiefly of massive and schistose greenstones, with more or less chloritic varieties, and with closely associated serpentines, the whole group having the characters of the typical Huronian series. For many of the details respecting these rocks, elsewhere given more at length, I am indebted to the courtesy of Rominger in permitting me to consult his yet unpublished Report of the Geological Survey of Michigan for 1881–1884. It appears from a letter by Emmons to Marcou, dated December, 1860, and published by the latter in 1885, that its author had long before "claimed that the Huronian was only the Taconic system."

It is now evident that two widely distinct and stratigraphically discordant series have, around the basin of Lake Superior, been confounded under the common name of Huronian. It should, however, be said that their distinctness was noted by Logan as early as 1847, when he described the lower division (Animikie —Lower Taconic) of his Upper Copper-bearing group (its upper division being the Keweenian) as resting, on the north shore of Lake Superior, unconformably upon the ancient greenstone and chloritic group, to which the present writer, in 1855, first gave the name of Huronian, and of which fragments are there found in the basal beds of the Lower Taconic.

§ 34. Taconic (Lower Taconic) rocks, according to Emmons, are found near the Hot Springs of Arkansas, and probably occur elsewhere farther west at the base of the palæozoic. Many concordant observations show the existence of a similar series in Cuba, Trinidad, and Venezuela, and also in Brazil, where they constitute the Itacolumitic series, already compared by Oscar Lieber with that described by him in South Carolina. I have called attention to the presence in the Alps of a great series lithologically similar to the Lower Taconic, including the so-called lustrous schists or sericite schists, with granular marbles, anhydrite, quartzites, etc., as well displayed in the Mont Cenis tunnel and in the Apuan Alps. These crystalline rocks have been by many European geologists regarded as altered strata of various ages, alike mesozoic and palæozoic, but are, in the opinion of Gastaldi, of Jervis, and many others, infra-Cambrian. Rocks lithologically and stratigraphically similar occur in Spain and in Norway, as I have elsewhere pointed out.

§ 35. It now became necessary to give distinctive terms to the two great groups of strata which, although originally separated by Eaton, were at first united by Emmons in one system, afterwards divided by him into Lower and Upper Taconic. It is unfortunate that the distinctive name of "Taconic slates" given by Emmons to the Upper Taconic division,—the First Graywacke or Cambrian,—solely for the sake of distinguishing it from the lithologically similar and often contiguous slates of the Second Graywacke or Ordovician (with which they had been confounded by his colleagues under the common name of Hudson River group), should have given rise to the false notion, entertained by some, that these Cambrian slates have a better title to the name of Taconic than the underlying Magnesian slate of Emmons—with its associated roofing-slate or Transition Argillite—and the still older crystalline limestones and quartzites; all of which were, together with the "Taconic slate" group, included from the first in the Taconic system of Emmons.

That the Taconic slate group or Upper Taconic was nothing more nor less than the Cambrian of the Appalachian valley has, we think, been made clear, and that the Lower Taconic is a wholly distinct and older series is also apparent. Its granular quartzites, often flexible; its crystalline limestones and dolomites, sometimes, like the quartzites, micaceous, and occasionally including amphibole and serpentine; its schistose beds, intercalated throughout, abounding in hydrous, non-magnesian micas, and occasionally carrying chlorite, talc, serpentine, garnet, and pyroxene; the presence also in the series of cyanite, staurolite, tourmaline, rutile, diamonds, and graphite; finally, the great included beds of magnetite, of hematite, and of siderite and pyrite, both yielding limonite by epigenesis,—all serve to show the existence of a peculiar and well-defined series of crystalline rocks, which are from four thousand to ten thousand feet in thickness, and are not less distinct from the uncrystalline Cambrian Graywacke or Upper Taconic than from those older crystalline series, the Laurentian, Arvonian, Huronian, and Montalban; upon each of which, in different regions, it appears to rest in unconformable stratification. It is at the same time overlaid in New Brunswick by the Cambrian (Menevian) slates of St. John, and in very many parts of the Appalachian valley by the Cambrian Graywacke, and elsewhere in that region by the Silurian (Oneida) sandstone, and apparently by the Ordovician (Trenton) limestone, as is also the case in Ontario.

§ 36. It became evident to the writer after many years of study of these rocks, that the attempt to set aside this great factor in American stratigraphy,—already recognized by Maclure, by Eaton, and by Emmons,—and to regard it, in conformity with the fancies of the metamorphic school, alternately as altered Cambrian, Ordovician, Silurian, Devonian, Carboniferous, and even Triassic,—was, like similar attempts in British and in European geology, a grave error.

The distinctness and unity of this great series of crystalline stratified rocks being maintained, a name for it was needed, and that of Lower Taconic given by Emmons was at hand. His Upper Taconic had by himself, and by others, been recognized as the equivalent of what had been previously designated Cambrian, a name which it was thought it should henceforth bear. To prevent confusion in nomenclature, to secure uniformity in terminology, and to connect the name of Emmons with his great achievements in American stratigraphy, the writer, in 1878, proposed for the Lower Taconic the name of Taconian, which he has since adopted.

§ 37. These rocks, although below the recognized Cambrian horizon, and, unlike them, essentially crystalline, are not destitute of the evidences of organic life. There are many reasons, both direct and indirect, apart from the existence of Eozoon, for believing that "the dawn of life," as Dawson has happily called it, began long before Taconian time. The typical *Scolithus linearis* of the basic quartzites of the Taconian,—although, as I have long since pointed out, very distinct from the somewhat similar markings (probably of two or more distinct species) found in the Cambrian (Potsdam) of the Ottawa and Mississippi basins, —is the more significant from the fact that it is found throughout the Appalachian valley, and, moreover, that something very like it, if not identical, occurs in the Taconian limestone alike in Pennsylvania and in South Carolina, as well as in the Taconian quartzites of Ontario. There also the limestones have yielded the remains of an organism, referred by Dawson to *Eozoon canadense*, filled not with a mineral silicate, as in the Laurentian serpentinic limestones, but with an earthy carbonaceous matter. To these should be added the occurrence of the remains of *Lingula*, found by Prime in the Taconian limestones of Pennsylvania, and of the remains of a keratose sponge in the argillite of this series, found by the writer in 1883 near Thomson, Minnesota. All of these facts (except the last) were insisted upon by the writer in 1876, and again in 1880, when in discussing the question whether the Taconian series is to be referred to eozoic or to palæozoic time, it was said that while to draw the line between them will be as difficult as to define that between palæozoic and mesozoic, or between mesozoic and cenozoic, "we may hope to find in the Taconic series a fauna which will help to fill the wide interval which now divides that of the eozoic rocks from the Cambrian;" adding that "we should seek in the study of stratigraphical geology not the breaks dividing groups from each other so much as the beds of passage which serve to unite all these groups in one great system."

§ 38. We have thus endeavored in the preceding pages to restate briefly the Taconic Question in some of its more important aspects. Further details, and the references to original sources, will be found in our recently published volume entitled "Mineral Physiology and Physiography," pp. 517–686. Therein appear the papers, published under the title of "The Taconic Question in Geology," in volumes i. and ii. of the "Transactions of the Royal Society of Canada in 1883 and 1884," in part rewritten and considerably augmented. In that volume will be found, on page 529, a tabular view (also published in the "Report on the Progress of Geology by the Smithsonian Institution for 1883"), wherein the stratigraphical sequence of the rocks of North America, including the Taconian series, and its relations alike to the older crystalline rocks below and to the First and Second Graywackes above, is shown to have been correctly indicated as early as 1832 by Amos Eaton, the preceptor of Ebenezer Emmons. Had the teachings of that great master in American geology been generally followed, it is not too much to say that a half-century of confusion, misconception, and controversy would have been avoided. It is the great merit of Emmons that he sought, though unsuccessfully and amidst cruel opposition and injustice, to uphold those teachings, and to the best of his ability to extend the generalizations of Eaton; in a return to which, as we have at last learned, is to be found the solution of the vexed problem of American stratigraphy.

In the tabular view above noticed the writer attempted to introduce for the first time into American geology the term Ordovician, proposed by Lapworth in 1879 for the group of strata between the proper Silurian of Murchison and the undisputed Cambrian of Sedgwick, which, though by the latter named Upper Cambrian, has been alternately called by others Lower Silurian, Siluro-Cambrian, and Cambro-Silurian, and includes the Chazy, Trenton, Utica, and Loraine subdivisions of the New York system. This name of Ordovician has since been adopted by many British and European geologists, and is now used by Mr. Charles D. Walcott, of the United States Geological Survey, whose important generalizations regarding the American Cambrian, noticed in the above volume, pages 624, 625, are given at length in his recent work in 1886, entitled "Studies of the Cambrian Faunas of North America" ("Bulletin No. 30 of the Geological Survey"), and constitute a precious contribution to our knowledge of the North American Cambrian. His table of the succession of the Cambrian, with its subdivisions, and the Ordovician, will be found on page 44 of that Bulletin.[1]

[1] Since writing the above paper there has appeared in the *American Journal of Science* for February, 1887, an abstract by Mr. Walcott of a paper read by him in January before the Philosophical Society of Washington, in which he puts forth again, with but slight modifications, the old metamorphic hypothesis touching the Taconian rocks, as maintained by Mather, H. D. Rogers, and C. B. Adams, since resuscitated by J. D. Dana, supporting it apparently upon the assumption that certain white sandstones carrying Olenellus, found to the eastward of the Taconic Hills, are identical with the Primitive Quartz-rock of Eaton, the basal division of the Taconian. While entertaining the highest regard for Mr. Walcott's admirable work in palæontology, the writer can see in his published note no ground for revising the conclusions already set forth in the preceding pages.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 133.)

AUSTRALIAN SPINAGE (?). *Chenopodium auricomum* Lind.

A NATIVE of Australia, Darling River to Carpentaria and Arnheim's Land, a tall perennial herb furnishing a nutritious and palatable spinage.[2] It does not appear in any way superior to the Garden Orach, except, perhaps, for warm climates.[3] It is mentioned as under culture in England in 1867,[4] but it has apparently not yet become common or general.

BALM. *Melissa officinalis* L.

This aromatic perennial, a native of the Mediterranean countries, has long been an inmate of gardens for the sake of its herbage, which finds use in seasonings and in the compounding of liqueurs and perfumes, as well as the domestic remedy known as balm tea. The culture was common with the ancients, as Pliny[5] directs it to be planted, and as a bee plant or otherwise it finds mention in the Greek and Latin poets and the prose writers.[6] It is mentioned in France by Ruellius[7] in 1536; in England by Gerarde,[8] 1597, who gives a most excellent figure, and also by Lyte[9] in 1586, and Ray[10] in 1686. Mawe,[11] in 1758, says great quantities are cultivated about London for supplying the markets. In the United States it is included among garden vegetables by McMahon[12] in 1806.

As an escape the plant is found in England,[13] and sparingly in the Eastern United States.[14] Bertero[13] found it wild on the island of Juan Fernandez.

But one variety is known in our gardens, although the plant

[1] Director of the New York Agricultural Experiment Station, Geneva.

[2] Mueller, Sel. Pl., 1876, 49.

[3] Vilmorin, The Veg. Gard., 377.

[4] Gard. Chron., 1867, 1215.

[5] Pliny, lib. xxi. c. 41.

[6] Theocritus, Idyll., iv. 25; Dioscorides, iii. 118; Varro, iii. 16; Columella, ix. 9; Virgil, Georgics, IV.; as quoted by Grandsagne, Pliny, vol. xiii. p. 485.

[7] Ruellius, De Stirp., 1536, 733.

[8] Gerarde, Herbal, 1597, 558.

[9] Lyte, Dod., 1586, 293.

[10] Ray, Hist., i. 570.

[11] Mawe's Gard., 1758.

[12] McMahon, Am. Gard. Kal., 1806.

[13] De Candolle, Geog. Bot., 681, 721.

[14] Gray, Syn. Fl. of N. A., ii., Pt. i., 361.

is described as being quite variable in nature. This would indicate that cultivation had not produced great changes. The only difference I have ever noted in the cultivated plant has been in regard to vigor. A variegated variety is recorded by Mawe [1] in 1778 for the ornamental garden, and is yet to be found.[2]

The names which have been given in various languages are: English, *bawme*, Lyte, 1586, *baulm, balm*, Blackw., 1750; Danish, *hjertensfryd*, Vil., 1883; French, *melissa*, Ruel., 1536, *melisse*, Dod., 1616, *melisse citronnelle*, Vil., 1883; German, *Melissenkraut, Mutterkraut*, Lyte, 1586, *Citronem-Melisse*, Vil., 1883; Greek, *melissovotanon, melissohorton*, Sibth.; Holland, *consilie de greyn, melisse*, Lyte, 1586, *citroen-melisse*, Vil., 1883; Italy, *cedronella, herba rosa*, Lyte, 1586, *melissa*, Dod., 1616, Vil., 1883; Spain, *torongil, yerva eidrera*, Lyte, 1586, *torongil, citronella*, Vil., 1883.

BASELLA. *Basella* sp.

The Basella species are natives of tropical Asia, and the leaves have been employed as a food in India and China. They have furnished a spinage plant to European gardeners now for many years.

Basella alba L.

This species is cultivated in Burmah [3] for spinage, in the Philippines [4] seemingly wild and eaten by the natives. It is also cultivated in the Mauritius,[5] and in every part of India,[6] where it occurs wild.[7] It was introduced to Europe in 1688,[8] and was grown in England in 1691,[9] but these references can hardly apply to the vegetable garden. It is, however, recorded in French gardens in 1824 and 1829.[10]

The vernacular names in Europe are: English, *White Malabar Nightshade;* Flanders, *Meier;* France, *Baselle blanche, Epinard blanc de Amerique, Epinard blanc de Malabar;* Germany, *Indischer gruner Spinat, Malabar Spinat;* Italy, *Basella;* Spain, *Basela.*[11]

[1] Mawe, l. c.
[2] Les Fleurs de Pleine Terre, 13th ed., p 692.
[3] Mason, v. 472–780; quoted from Pick. Ch. Hist., 696.
[4] Blanco; quoted from Pick. Ch. Hist., 696.
[5] Bojer, Hort. Maurit., 1837, 270.
[6] Drury, Useful Plants of India, 66.
[7] Wight, ic., pl. 896.
[8] Noisette, Man. du Jard., 559.
[9] Mill. Dict., 1807.
[10] L'Hort. Franc., 1824; Noisette, l. c., 1829.
[11] Vilmorin, Les Pl. Pot., 30.

In the Mauritius, *gandolle blanc;* [1] in the Indian languages, Bengali, *sufed-pooin;* in Telinga, *allu-batsalla;* in Hindustani, *poi;* [1] in Burmah, *gyen baing*,[2] etc.

Basella cordifolia Lam. (*B. lucida* Lam.)

This species is cultivated in all parts of India,[3] and is the *Calalue* of Barbadoes.[4] It was imported from China to France in 1839,[5] and is now known under the name of *Baselle de Chine a tres larges feuilles.* Its greater expanse of leaves makes it more desirable as a spinage plant than the other species.

The vernacular names in India are: Bengali, *pooinshak;* Telinga, *pedda-batsella;* Hindustani, *pooi*.[6]

Basella nigra Lam.

This species is found in Cochin China and China, both wild and uncultivated,[7] and Livingston [8] says the leaves are much esteemed when boiled. It is very likely but a variety of the other species.

Basella rubra L.

This Indian species is cultivated as a spinage plant in many places. In 1638, according to the "Hortus Malabaricus," seed was sent from Ceylon to the botanic garden at Amsterdam,[9] and Ray,[10] in 1704, describes it as cultivated in gardens. No mention of it in kitchen gardens, however, occurs before the present century. It is mentioned in French works on gardening in 1824, 1826, and 1829,[11] and in the Mauritius in 1827.[12] Bretschneider [13] has found mention of it as a cultivated vegetable in Chinese authors of the sixteenth century, 1640, and 1742. Kaempfer describes it as a Japanese plant, and Rumphius as of Amboina.

The European names are: *Red Malabar Nightshade* in Eng-

[1] Drury, l. c.

[2] Pickering, Ch. Hist. of Pl., 696. Other names will be found in Birdwood, Veg. Prod. of Bomb., 177.

[3] Firminger, Gard. in Ind.; Drury, l. c.

[4] Maycock, Fl. Barb., 131.

[5] Vilm., l. c.

[6] Drury, l. c.

[7] Loureiro, Fl. Cochinch., 183.

[8] Livingston, Hort. Trans., v. 54.

[9] Mill. Dict., 1807.

[10] Ray, Hist. Suppl., 1704, iii. 358.

[11] L'Hort. Franc., 1824; Petit, 1826; Noisette, 1829.

[12] Bojer, l. c.

[13] Bretschneider, Bot. Sin., 59, 83, 85.

lish; in France, *Baselle rouge, Epinard rouge d'Amerique, Epinard rouge de Malabar;* in Germany, *Rother Malabar-spinat.*[1]

The extra European names I find are as follows: Mauritius, *bredes gandolle ou d'Angole;*[2] in Japan, *murasakki;*[3] in India, *poee sag;*[4] in Sanscrit, *pootika;* in Bengali, *racta-bun-pooi;* in Telinga, *yerra-batsalla;* in Ceylon, *rat-niwiti.*[5]

Basil. *Ocimum* sp.

Various kinds of basil have been grown in vegetable gardens since a remote period, for the sake of the aromatic foliage which serves as a seasoning. In 1778, Mawe names thirteen varieties, the broad-, narrow-, and fringed-leaved, the dark green, the large purple and the fringed purple, the tricolored, the curled- and the studded-leaved, the red- and the purple-flowered, the long-spiked and the short-spiked. At the present time Vilmorin describes ten kinds as serviceable for the kitchen garden. In 1612, "Le Jardinier Solitaire" devotes a section to directions for culture, and Quintyne, in 1693,[6] grew basil among hot-bed plants. According to Miss Bird,[7] the seeds are eaten in Japan.

Ocimum basilicum L.

This species is a very variable one, and furnishes a number of botanical varieties. It includes the large varieties of our gardens, in both the green- and purple-foliaged, the large-, medium-, and narrow-leaved. It is a native of tropical Asia, and is described for India by Drury, for Cochin China by Loureiro, for Amboinia by Rumphius, for Malabar by Rheede, etc. It was probably known to the ancients, but the commentators are often in doubt as to the name. Fee[8] thinks it the *okimon* of Hippocrates, Theophrastus, and Dioscorides, the *ocimum hortense* of Columella and Varro. It reached England on or before 1548, according to McIntosh;[9] certain it is, it is not mentioned by Turner in his "Libellus," 1538, and is well known to Lyte in 1586. It occurs in all the American works on gardening, commencing with 1806.

[1] Vilm., l. c.
[2] Bojer, l. c.
[3] Kaempfer, Amœn., 1712, 784.
[4] Speede, Ind. Handb. of Gard., 1842, 155.
[5] Birdwood, Veg. Prod. of Bomb., 177.
[6] Quintyne, Comp. Gard., 1693, 188.
[7] Unbeaten Tracks in Japan, i. 238.
[8] Fee, Notes in Grandsagne's Pliny.
[9] McIntosh, Book of the Gard., ii. 237.

In our synonymy we can include all the varieties named by Vilmorin as in present culture, and all those mentioned in the vernacular by less recent writers. A careful examination seems to justify the following attempts :

I.

Ocimum mediocre. Fuch., 1542, 548.
Basilica minor. Trag., 1552, 30.
O. parvum. Matth., 1558, 268.
O. medium vulgatius. Adv., 1570, 215; Lob. Obs., 1576, 268.
O. secundum. Cam., Epit., 1586, 309.
O. medium. Lugd., 1578, 680.
O. medium citratum. Ger., 1597, 547.
Basilicum medium. Hort. Eyst., 1613, Æst. ord., 7, fol. 9.
O. vulgaris. Bauh., Pin., 1623, 226.
? *O. basilicum* L. Sp., 2d ed., 833.
Basilic grand vert and *grand violet.* Vil., 1883, 31.
Sweet Basil and *Purple Sweet Basil.*

II.

Ocimum magnum. Fuch., 1542, 549.
Basilica major. Trag., 1552, 31.
O. max. caryophyllatum. Lob. Obs., 1576, 268; *ic.*, 1591, i. 503.
Ocimum. Cam., Epit., 1586, 308.
O. maximum. Lugd., 1587, 679.
O. garyophyllatum majus. Bauh., Phytopin., 1596, 425.
O. magnum. Ger., 1597, 547.
? *O. basilicum*, var. *b.* Lin., Sp., 2d ed., 833.
Basilic a feuilles large. De C., Fl. Fran., 1815, iii. 570.

III.

Ocimum anisatum. Hort. Eyst., 1613, Æst. ord., 14, fol. 2.
Basilic anise. Vil., 1883, 32.

IV.

Ocimum latifolium crispum. Matth., 1598, 408.
O. crispum viride. Hort. Eyst., 1613, Æst. ord., 7, fol. 10.
O. foliis fimbriatis viridis. Bauh., Pin., 1623, 225.
O. Sancto mauritanum. J. Bauh., 1651, iii. 249.

O. Basilicum L., var. *f.* Benth.
Basilic frise. Vil., 1883, 32.

V.

Ocimum latifolium magnum. Hort. Eyst., 1613, Æst. ord., 7, fol. 10.
O. viride foliis bullatis. Bauh., Pin., 1623, 225.
O. basilicum, var. d. Lin., Sp., 2d ed., 833.
O. bullatum. Lam. ex De C., Fl. Fran., III, 570.
Basilic a feuilles de laitue. Vil., 1883.

In the European languages Basil or Sweet Basil is called, in Denmark, *basilikum;* in Flanders, *basilik;* in France, *basilic grand, B. aux sauces, B. des cuisiniers, B. romain, herbe royale;* in Germany, *Basilicum,*[1] *Basilien, Basilgram;*[2] in Italy, *basilico;* in Portugal, *manjericao;*[1] in Russia, *wasilik;*[3] in Spain, *albaca, albahaca.*[1]

Outside of Europe it is called, in Arabic, *ryhan,*[4] *riban, habak;*[5] in Sanscrit, *manjirika;*[6] in Bengali, *barbooitulsee;* in Hindustani, *kala-tulsee, pashana cheddu;* in Tamil, *tirnoot-patchie;* in Telinga, *vepoodipatsa;*[7] in Persia, *deban-shab, nazbro, ungooshtkuneezuckan,*[6] etc.

Ocimum gratissimum L.

This species is recorded as indigenous from India, the South Sea islands, and Brazil.[8] According to Loureiro,[9] it occurs in the kitchen gardens of Cochin China. It was cultivated in England in 1752 by Mr. Miller.[10] Forskal[11] gives as the Arabic name, *hobokbok.* In French gardens[12] this plant is called *basilic en arbre.* Vilmorin thinks, however, that the French form may be the *O. suave* Willd., but of this he is not certain.

Ocimum minimum L.

This smaller species is a native of India, but is recorded from Cochin China and from Chili. From its compact form it is much grown in gardens, and has furnished several varieties. It is not

1 Vilmorin, Les Pl. Pot., 31.
2 Camerarius, Epitome, 1586, 308.
3 McIntosh, Book of the Gard., ii. 238.
4 Delile, Fl. Ægypt, illust.
5 Forskål, Fl. Æg. Arab., c. xiv.
6 Birdwood, Veg. Prod. of Bomb., 64, 241.
7 Drury, Useful Pl. of Ind., 326.
8 Mueller, Sel. Pl., 1876, 143.
9 Loureiro, Fl. Cochinch., 369.
10 Miller's Dict., 1807.
11 Forskal, l. c.
12 Vilmorin, l. c.

mentioned in Turner's "Libellus," 1538, and hence had probably not reached England at this time. It has been known in American gardens from the commencement of the present century, and probably earlier.

The synonymy can be established as below:

I.

Ocimum exiguum. Fuch., 1542, 547.

O. minimum amaraci figura caryophyllata. Adv., 1570, 215; Lob. Obs., 1576, 269.

O. caryophyllatus. Lugd., 1587, 681.

O. minus garyophyllatum. Ger., 1597, 547.

O. garyophyllatum. Matth., 1598, 407.

Basilico minore. Cast. Durante, 1617, 64.

O. minimum. Bauh., Pin., 1623, 226; J. Bauh., 1651, iii. 247; Ray, 1686, i. 541.

O. mimimum. L., Sp., 833.

Bush basil. Lyte, 1586; Ger., 1597; Ray, 1686; Burr, 1863.

Basilic fin, vert and violet. Vilm., 1883, 33.

II.

Ocimum min. caryophyllatum. Hort. Eyst., 1613, Æst. ord., 7, fol. 10.

Basilic fin vert compact. Vil., Alb. de Clich., n. 43077.

Compact Bush-basil. Vil., Veg. Gard., 1885, 19.

Bush basil is called in India *Sofed toolsee;*[1] in Italy, *Basilico gentile, Basilico garosonato;*[2] in France, *Basilic fin;* in Spain, *Albaca menuda, A. fina.*[3]

We certainly cannot find in basil an illustration of great modifications which have been produced by cultivation, nor can we suspect that there are any well-marked varieties of modern origination.

BEAN. *Phaseolus vulgaris* L.

When the bean was first known it was an American plant, and had a culture extending over nearly the whole of the New World, as it finds mention by nearly all the early voyagers and explorers, and while the records were not kept sufficiently accurate to justify identification in all cases with varieties now known, yet the

[1] Speede, Ind. Handb. of Gard., 184. [2] Cast. Durante, 1617.

[3] Vilmorin, l. c.

mass of the testimony is such that we cannot but believe that beans as at present grown were included. A partial list of such testimony I have given heretofore,[1] and hence it need not be repeated. The marvellous number of varieties known are indication of antiquity of culture, and when kept from crossing these varieties come true and perpetuate indefinitely characters which appear in the seed. From seed apparently on type, however, through atavism, other varieties may appear, and to one unfamiliar with the types might be considered as sports, and as proof of the variable nature of the plant.[2]

Commentators have quite generally considered this species as among the plants cultivated by the ancients, and De Candolle,[3] who has given the subject much thought, thinks the best argument is in the use of the modern names derived from the Greek *fasiolos* and the Roman *faseolus* and *phasiolus*. In 1542, Fuchsius[4] used the German word *Faselen* for the bean; in 1550, Roszlin[5] used the same word for the pea, as did also Tragus[6] in 1552. Fuchsius gives also an alternative named *welsch Bonen*, and Roszlin *welsch Bonen* and *welsch Phaselen* for the bean, and the same word, *welsch Bonen*, for the bean is given by Tragus, 1552, and Kyber,[7] 1553. This epithet, *welsch* or *foreign*, would seem to apply to a kind not heretofore known. Albertus Magnus,[8] who lived in the thirteenth century, used the word *faselus* as denoting a specific plant, as "faba et faseolus et pisa et alia genera leguminis," "cicer, faba, faseolus." He also says, "Et sunt faseoli multorum colorum, sed quodlibet granorum habet maculam nigram in loco cotyledonis." Now the *Dolichos unguiculatus* L. is a plant which furnishes beans with a black eye, as grown by me, and appears the same with many varieties of the "cow pea" of the Southern States, and is stated by Vilmorin to be grown in Italy in many varieties. I have before me, as I write, two hundred and nineteen bottles of beans, each with a distinct name (many, however, synonymes), and not one of these beans has a black eye. I have before me the seed of

[1] Kitchen Garden Plants of Am. Origin, Am. Naturalist, May, 1885, 448, 452.

[2] See Proc. of Am. Asso. for Adv. of Sc., 1885, xxxiv. 283.

[3] De Candolle, Orig. des Pl. Cult., 271.

[4] Fuchsius, De Hist. Stirp., 1542, 708.

[5] Roszlin, Kreuterbuch, 1550, 149.

[6] Tragus, De Stirp., 1552, 611.

[7] Kyber, Lexicon, 1553, 404.

[8] Albertus Magnus, De Veg., Jessen ed., pp. 118, 167, 515.

Dolichos unguiculatus and twelve named varieties of the cow pea, and all have a circle of black about the white eye, also one variety of cow pea all black, with a white eye, and one red speckled form without the black. It seems, therefore, reasonable to conclude that the *faselus* of Albertus Magnus was a Dolichos. In the list of vegetables Charlemagne ordained to be planted on his estates occurs the word *fasiolum*, without explanation.[1]

Passing now to the Roman writers, Columella[2] speaks of the "longa fasellus," an epithet which well applies to the pods of the Dolichos; he gives directions for field culture and not for garden culture, recommending the seeding to be four *modii per jugerum*, and he recommends planting in October. Pliny[3] says the pods are eaten with the seed, and the planting is in October and November. Palladius[4] recommends the planting of *faselus* in September and October, in a fertile and well-tilled soil, four *modii per jugerum*. Virgil's[5] epithet, "vilemque phaselum," also indicates field culture, as to be cheap implies abundance.

Among the Greek writers, Aetius,[6] in the fourth century, says the *Dolichos* and the *phaseolus* of the ancients were now called by all *lobos*, and by some *melax* (smilax ?) *kepea*. This word *lobos* of Aetius is recognizable in the Arabic *loubia*[7] applied to *Dolichos lubia* Forsk., a bean with low stalks, the seed ovoid, white, with a black point at the eye. Galen[8] says the *lobos* was called by some *phasiolos*.

From these and other clues to be gleaned here and there from the Greek authors, I am disposed to think that the low bean of the ancients was a Dolichos, and that the word *phaselus* referred to this bean whenever used throughout the middle ages in speaking of a field crop.

The Roman references to *phaseolus* all refer to a low-growing bean fitted for field culture, and so used. There is no clear indication to be found of garden culture. Aetius seems the first among the Greeks to refer to a garden sort, for he says the *lobos* are the only kind in which the pod is eaten with the bean, and

[1] Quoted from De Candolle, Orig. des Pl. Cult., 272.

[2] Columella, lib. x. l. 378; lib. ii. c. 10; lib. xi. c. 2.

[3] Pliny, lib. xviii. c. 33. [4] Palladius, lib. x. c. 12; lib. xi. c. 1.

[5] Virgil, Georgics, i. 227. [6] Quoted by Bodæus a Stapel, Theophrastus, 1644, 925.

[7] Delile, Mem. sur les Pl. cult. en Egypte, 24.

[8] Galen, De Aliment, c. xxviii.

he says this *lobos* is called by some *melax kepea* (smilax hortensis), the *dolichos* and *phaseolus* of his predecessors. Galen's use of the word *lobos*, or the pod plant, would hence imply garden culture in Greece in the second century.

The word *loubion* is applied by the modern Greeks to the *Phaseolus vulgaris*, as is also the word *loba* in Hindustani. The word *lubia* is applied by the Berbers, and in Spain the form *alubia* to the *Phaseolus vulgaris*.[1] The words *fagiuolo* in Italian, *phaseole* in French, are used for the *P. vulgaris*. It is so easy for a name used in a specific sense to remain while the forms change, as is illustrated by the word squash in America, that we may interpret these names to refer to the common form of their time, to a Dolichos (even now in some of its varieties called a *bean*) in ancient times and to a Phasiolus now.

Theophrastus[2] says the *dolichos* is a climber, and bears seeds, and is not a desirable vegetable. I find no other mention of a climber in the ancient authors. The word *dolichos* seems to be used in a generic sense. Theophrastus says *the his dolichos*, the intensive *z* being used after the *o*; but the *dolichos* of Galen is the *faselus* of the Latins, for he says that some friends of his had seen the *dolichos* (a name not then introduced at Rome) growing in fields about Caria, in Italy. We may hence be reasonably certain that the pole beans which were so common in the sixteenth century were not then cultivated.

The English name *kidney beans* is derived evidently from the shape of the seed. Turner, 1551, is the first use of this name I note; but they were not generally grown in England until quite recent times. Parkinson, in 1629, speaks of them as oftener on rich men's tables, and Worlidge, in 1683, says that within the memory of man they were a great rarity, although now a common delicate food. The French word *haricot*, applied to this plant, occurs in Quintyne,[3] 1693, who calls them *aricos* in one place, and *haricauts* in another. The word does not occur in "Le Jardinier Solitaire," 1612, and Champlain,[4] in 1605, uses the term *febues du Bresil*, indicating he knew no vernacular name of closer application. De Candolle[5] says the word *araco* is Italian,

[1] De Candolle, Orig. of Cult. Pl., 278.

[2] Theophrastus, c. 3. Bodæus a Stapel, 1644, 914.

[3] Quintyne, Comp. Gard., 1693, 185, 142.

[4] Champlain, Voy. Prince Soc. Ed., 64.

[5] De Candolle, Orig. of Cult. Pl., 274.

and was originally used for *Lathyrus ochrus*. It is apparently thus used by Oribasius and Galen.

The two species of Linnæus, *Phaseolus vulgaris* and *P. nana*, correspond to the popular grouping into pole and dwarf beans. But there is this to be remarked, that Linnæus synonymes for *P. nana* apply to a Dolichos, and not to a Phaseolus, for the descriptions of *Phaseolus vulgaris italicus humilis s. minor, albus cum orbita nigricante* of Bauhin's[1] history answer well to the cow pea, as also does C. Bauhin's[2] *Smilax silique sursum rigente s. Phaseolus parvus italicus*, and do not apply to the bush bean. The figures given by Camerarius[3] in 1586, by Matthiolus,[4] 1598, and by Bauhin, 1651, are all cow peas, although the names given are those used for the true bean, thus indicating the same confusion between the species and the names which kept pace with the introduction of new varieties of the bean from America, for Pena and Lobel,[5] in 1570, say that many sorts of *fabas Pheseolosve* were received from sailors coming from the New World.

Phaseolus nana L.

The first figure I find of the bush bean is by Fuchsius,[6] in 1542, and his drawing resembles very closely varieties that may be found to-day,—not the true bush, but slightly twining. In 1550, Roszlin[7] figures a bush bean, as does Matthiolus[8] in 1558, Pinæus[9] in 1561, and Dalechamp[10] in 1587. Matthiolus says the species is common in Italy, in gardens, and oftentimes in fields, the seed of various colors, as white, red, citron, and spotted. Dalechamp figures the white bean. The dwarf bean is not mentioned by Dodonæus[11] in 1566 nor in 1616. A list of varieties cultivated in Jamaica is given, in 1837, by Macfadyen,[12] which includes the one-colored black, yellow, red, etc.; the streaked, in which the seeds are marked with broad, linear curved spots; the variegated, the seeds marked with rubiginose, leaden, etc., more or less rounded spots; and the saponaceous, with the back of

[1] Bauhin, Hist., 1651, ii. 258.
[2] Bauhin, Pin., 1623, 339.
[3] Camerarius, Epit., 1586, 212.
[4] Matthiolus, Op., ed. Bauhin, 1598, 341.
[5] Pena and Lobel, Adversaria, 1570, 394.
[6] Fuchsius, De Stirp., 1542, 708.
[7] Roszlin, Kreuterbuch, 1550, 149.
[8] Matthiolus, Comm., 1558, 237.
[9] Pinæus, Hist. Plant., 1561, 140.
[10] Hist. Gen. Lugd., 1587, 472.
[11] Dodonæus, Frument., 1566.
[11] Dodonæus, Pempt., 1616.
[12] Macfadyen, Jam., i. 283.

the seeds white, the sides and concavity marked with spots so as to resemble a common soap-ball.

Gerarde,[1] 1597, does not mention this bean in England, but it is mentioned by Miller,[2] in 1724, in varieties which can be identified with those grown at the present time, five in all. In 1765, Stevenson[3] names seven varieties; in 1778, Mawe[4] names eleven. In 1883, Vilmorin[5] describes sixty-nine varieties and names others.

Phaseolus vulgaris L.

Pole beans are figured by Tragus[6] in 1552, who speaks of them as having lately come into Germany from Italy, and he calls them *welsch* or foreign, and he enumerates the various colors, as red, purplish white, variegated, white, black, and yellowish. Dodonæus[7] in 1566 and 1616 figures the pole bean, as does Lobel[8] in 1576 and 1591, Clusius[9] in 1601, and Castor Durante[10] in 1617. In 1597, Gerarde[11] figures four varieties in England, the white, black, red, and yellow, and Barnaby Googe[12] speaks of *French beans* in 1572, indicating by the name the source from which they came. In 1683, Worlidge[13] names two sorts as grown in English gardens, and the same varieties are given by Mortimer[14] in 1708. In France, in 1829, nineteen sorts are enumerated by Noisette,[15] and in 1883, Vilmorin[16] describes thirty-eight varieties and names others.

The bean is called in England *kidney bean*, Turner, 1551, Vilm., 1883; *French bean*, Vil., 1883; *sperage bean*, Ger., 1597, Googe, 1572; *faselles, long peason, garden smilax, Romane beans*, Lyte, 1586; in Denmark, *havebonnen*, Vilm., 1883; in Flanders, *boon*, Vilm., 1883; in France, *febues*, Cartier, 1536, *fasiolis*, Pin., 1561, *haricot*, Quint., 1693, Vilm., 1883, *phaseole*, Vilm., 1883; in Germany, *welsch Bonen*, Fuch., 1542, *Bohne*, Vilm., 1883; in Greece, *fasoulia*, De C., 1883; in Holland, *boon*, Vilm., 1883; in

[1] Gerarde, Herbal, 1597, 1038.
[2] Miller's Dict., 1807.
[3] Stevenson, Gard. Kal., 1765, 66.
[4] Mawe, Gard., 1778.
[5] Vilmorin, Les. Pl. Pot., 250.
[6] Tragus, l. c.
[7] Dodonæus, l. c.
[8] Lobel, Obs., 1576, 511; ic., 1591, ii. 60.
[9] Clusius, Hist., 1601, ii. 222.
[10] Castor Durante, Herb., 1617.
[11] Gerarde, Herbal, 1597, 1038.
[12] Gard. Chron., 1864, 1181.
[13] J. W. Gent., Systema-Hort., 1683, 197.
[14] Mortimer, The Whole Art of Husbandry, 1708, 456; quoted from Gard. Chron., 1864, 1013.
[15] Noisette, Man., 1829, 361.
[16] Vilmorin, l. c.

Italy, *fagiuolo*, Pin., 1561, Vilm., 1883; in Portugal, *feijao*, Vilm., 1883; in Spain (in Castile), *arvejas luengas*, (in Aragon) *judias*, Oviedo, 1546, *faxones fexoes*, *frejoles*, Navarette, about 1500, *fasiolos*, Cam., 1586, *habichuela*, *judia*, *frijol*, Vilm., 1883; in Sweden, *Turkiska boner*, Tengborg, 1764.

In India, in Hindustani, *bakla*, *loba*; in Ceylon, *dambala*, Birdwood; in Cochin China, *dau tlang*, *tau*, Lour.

In America, the Northern Algonquins, *tuppuhquam-ash*,—*i.e.*, twiners, Elliott; in Carib, *calaouana*, Breton's Dict.; in Chahta, *tobi*, Gray; in Chippeway, *miskodissimin*,—*i.e.*, red-dyed seed, Gray; in Dakota, *onmnicha*, Gray; in Delaware, *malachxit*, Zeisberger; in Huron, *ogaressa*, Sagard; in Kennebec Abnaki, *a 'teba 'kive*, Rasle; in Mohawk, *osaheta*, Gray; Mojave, *se-van*, Whipple; in the Narragansett, *monasquisset* (singular), Cotton, *manusqussed-ash* (plural), R. Williams; in Onondaga, *onsahita* and *hosahita*, Shea; in Pequod, *mushquissedes*, Stiles; in Peru, *purutu*, de Vega; on the St. Lawrence, *sahe*, Cartier; the Shawanoes of Ohio, *m'skochi-tha*, Gray; the Cheyenne, *monisk* or *monehka*, Hayden; in Virgina, *okindjier*, Haricot, *peccatoas*, *peketawes*, Strachey;[1] Yuma, white beans, *marique*, Whipple.

In Mexican, *etl* of the Aztecs; when boiled in the green pod *exotl*, Bancroft.

It should not be overlooked that this bean has been found in the ancient Peruvian tombs at Ancon;[2] that Verarzanus,[3] an Italian, in 1524, previous to the recorded introduction of the bean to Italy, in describing those met with on the New England coast, says, "differing in colour and taste fro' ours, of good and pleasant taste;" and Harriot,[4] in 1586, when kidney beans were scarcely in general culture in England, notes in Virginia that the beans are different from those of England in that they are "flatter, of more divers colours and some pied. The leaf also of the stem is much different."

[1] These Indian names mostly taken from Gray and Trumbull, Am. Jour. of Sc., August, 1883.

[2] Stevenson, Trav., i. 328; De Candolle, Orig. des Pl. Cult., 273.

[3] Verarzanus, Hakluyt, Divers Voy. to Am., 60.

[4] Harriot, Pink. Voy., xii. 595.

(To be continued.)

METSCHNIKOFF ON GERM-LAYERS.[1]

TRANSLATED BY H. V. WILSON.

SOME of the most fundamental principles of the comparative embryology of to-day can be traced back, with a greater or less change of form, to the beginning of the century. Among such is the idea embodied in the following law, which was enunciated by the school of natural philosophers in Germany: "The evolution undergone by every animal from the beginning of its life corresponds to the evolution which is to be observed in the series of animals." The law as thus stated met with opposition from Von Baer (1),[2] who maintained that the embryonic stages of an animal are by no means to be compared with other adult forms, but with the embryos of these forms. He had finally to admit, however, that the difference between these two views is not nearly so great as it appears to be at first sight.

Already animated by this philosophical generalization, embryology received a great stimulus from the parallel Louis Agassiz drew between the embryonic stages of existing animals and the main stages in the geological development of the animal kingdom. Agassiz himself failed to make the right deductions from this truth.

While students of embryology were thus engaged in looking for general points of similarity, on the one hand, between embryonic stages of animals and existing adult forms, and between embryos and extinct animals on the other, Huxley, in 1849, instituted the comparison between the germinal layers of Vertebrates and the layers of the Cœlenterate type. To the latter he gave the names of ectoderm and endoderm. This idea did not remain unnoticed in England, but was generalized and given a popular character by Herbert Spencer in one of his beautiful essays, entitled "The Social Organism." Let me quote from the English philosopher: "Throughout the whole animal kingdom, from the Cœlenterata upward, the first stage of evolution is the same. Equally in the germ of a polype and in the human ovum, the aggregated mass of cells out of which the creature is to

[1] The following paper forms the closing chapter of Professor Elias Metschnikoff's "Embryologische Studien an Medusen," Wien, 1886.

[2] The numbers in this article refer to the bibliographical list appended.

arise, gives origin to a peripheral layer of cells, slightly differing from the rest which they include; and this layer subsequently divides into two,—the inner, lying in contact with the included yelk, being called the mucous layer, and the outer, exposed to surrounding agencies, being called the serous layer: or, in the terms used by Professor Huxley in describing the development of the Hydrozoa, the endoderm and ectoderm. This primary division marks out a fundamental contrast of parts in the future organism." The share each layer takes in building up the developing animal is then touched upon, after which the author proceeds to draw an analogy between the layers of an animal body and the grades of society, in which he compares the ectoderm with the higher grades, the endoderm with the lower grades, and the mesoderm with *tiers-état.*

Huxley's theory for a long time found no supporters in Germany. In that country there was noticeable a certain reaction against the general application of the doctrine of the germinal layers. This reaction reached its greatest height in the well-known paper by Weismann on the embryology of the Diptera. Such a tendency was in perfect accord with the doctrine of types then prevalent, according to which morphological comparisons could only be made within the limits of one and the same great group.

The similarities in the structure and development of animals were long regarded as the expression of a universal plan, which was of a purely ideal nature. In the last two decades it has been generally recognized that at the bottom of these similarities lies genetic relationship. The value of embryology as a key to this relationship was recognized by Darwin, who laid special emphasis on the view that the embryo, being less differentiated than the adult, ought to afford us valuable information concerning the structure of its ancestors; and that when the embryos of two animals are alike, the similarity is due to a common descent. He attempted to illustrate these general laws by concrete examples, and where he met exceptions, he explained them by supposing the embryonic record to be obscured by larval adaptations and precocious inheritance. Darwin thus came to the conclusion that the parallel Agassiz had pointed out is due to the blood relationship of animals, and that this parallel is thoroughly revealed only in cases where the process of development has not been altered by the introduction of any obscuring disturbance.

The embryological principles of Darwin were developed in a deductive manner by Fritz Müller in his important little book, "Für Darwin," and were illustrated by many facts chosen from the life histories of the lower animals. The way Müller looked at his facts revealed the manner in which the problems of comparative embryology must be approached in future. He especially emphasized his belief that individual development only repeats genealogical development in cases where the descendants (in the course of their embryology) travel without swerving the straight path which leads up to their ancestral form, "where, however, they do not stop, but press farther on." "In the short space of a few weeks or months," says Müller, "the ever-altering forms of the embryos and larvæ present to our eyes a more or less perfect picture of the changes through which, in the course of countless ages, the species has struggled up to its present condition." In connection with Darwin's ideas on the disturbance of the developmental process, Müller formulated this proposition: "The historical record preserved in the development of the individual is gradually lost, since there is always at work a tendency to make the path from the egg to the adult as straight as possible. The record is, moreover, falsified because of the struggle for existence in which the larvæ that lead an independent life have to take part."

This book of Müller's marked an epoch; and in part under its influence there was soon begun a very active overhauling of the facts of animal embryology, in which more attention was paid to the lower animals than to the higher Vertebrates. Independently of this movement, Kölliker, in 1865 (in the second part of his "Icones Histologicæ," p. 90), came to certain general conclusions, which essentially coincided with the views of Huxley. "Whatever the cause may be," says Kölliker, "the uniformity in structure of a Hydrozoan and a young Vertebrate embryo is a very striking fact; and if this question is pursued further with an eye to the structure and histological development of many animals, it is pretty certain that some simple law of development will be discovered. The problem was before long a subject of busy investigation. The forsaken theory of the germinal layers was again taken up in the realm of the Invertebrates, and was enriched with many fresh facts, so that it soon became the password to the new road upon which embryology had entered. The theory received the greatest impulse from Kowalevsky's discovery of the development of Amphioxus (2). The embryology of this animal disclosed phenomena which linked together the development of Vertebrates and Invertebrates. As soon as Kowalevsky had discovered the two-layered ciliated larva of Amphioxus he began to look for analogous embryonic forms in other animals, and succeeded in establishing a great number of very valuable facts. These investigations, having for their object the discovery of the most fundamental embryonic forms, such as might be compared with the early stages of Amphioxus, were naturally followed out on animals of low grade with simply organized larvæ. On the other hand, I turned my attention to the development of the higher Invertebrates, with the design of establishing here also the germ-layer theory. I first studied the embryology of Sepiola (4), found two germinal layers, and observed the part each played in building up the organism. Following up the investigation in the group of Arthropods, I failed to demonstrate satisfactorily the germinal layers in Insects, but found them in the higher Crustacea (5) (Nebalia), and particularly well in the scorpion (6). In the latter animal I at first (1866) found only two layers, but soon after (1868) discovered the third. I showed in the scorpion that the upper layer gives rise to the central nervous system; that the middle splits into two layers and forms a series of hollow segments, by the fusion of which the body cavity arises; and that, finally, the under layer becomes the lining membrane of the alimentary canal. Supported by these facts, I concluded, in 1869 (in a publication of the Educational Bureau), that the three layers of the scorpion embryo corresponded in all respects to the three Vertebrate layers. I was not deterred from this view by my belief at the time that the nerve-fibres were derived from the middle instead of the upper layer, since the peripheral nervous system of the Vertebrates was then generally considered to be mesoblastic. Thus the problems of comparative embryology were attacked on two sides, with the object of getting a good basis of facts. It was not until I had made out the main features in the formation of the germinal layers of the scorpion that Kowalevsky began to investigate the embryology of the Oligochæta and Insecta (3). He found in these animals the same three layers, and carefully studied their changes. The rejuvenated germinal-layer theory had now gained a firm basis in the domain of the Invertebrates, and comparative embryology took a new direction, mainly under the guidance of German and Russian investigators. Since the idea of the germinal layers was taken from the higher animals, and was then applied to the Invertebrates, it was natural that misconceptions should arise, owing to such an anti-genealogical method. Some of these misconceptions have lasted until to-day; for instance, in cases where the determination of the several layers is beset with doubt there is often too much stress laid upon purely topographical characteristics. The Orthonectidæ and Dicyemidæ afford two such cases. In these animals certain cells, whose function is generative, are styled endoderm, merely because they lie beneath the external layer. Ed. van Beneden (14, 15) goes so far as to consider the topographical position as the one guide in determining the germinal layers. To quote his own words: "We designate as endoderm the layer or mass of cells which is enclosed, whatever be the tissues derived from it." Haeckel must in this respect be accredited with having made an important step forwards, when he sharply formulated the view, according to which the germinal layers, or at least the two chief layers, are to be regarded as primitive organs (16). From this stand-point a structure in question could only be called endoderm when it possessed several characteristics of this primitive organ, and not when it merely agreed with the organ in topographical position. If, for example, the enclosed mass of cells in the Orthonectidæ were digestive in function there would be no doubt that they represented an endoderm; but since the cells in question are sexual cells, there is very considerable doubt. The main difficulty in the determination of the layers is due to the fact that the genealogy of the germinal layers does not rest on a safe basis, since we know nothing of the primitive condition of the Metazoa. To get an idea of their original condition one must frame hypotheses, such as coincide with as many facts as possible. From a mere hypothesis the doctrine of descent grew to a stable theory as soon as it was shown what a number of phenomena were explicable with its aid and that no fact contradicted it. In like manner hypotheses, which seek to elucidate the original condition of the above-mentioned primitive organs, should only be given the rank of theories when they are in harmony with our actual knowledge.

The transitional stages between the Protozoa and Metazoa do not appear to exist at the present day. Endeavors have been made, however, to fill this gap in our knowledge by means of hypothetical organisms. There are two ways possible for such a transition to take place,—either by a differentiation of protoplasm around the separate nuclei of a multinucleate protozoan, or by the union of the several individuals of a protozoan colony into a many-celled individual. We will discuss the former method of transition first, and then take up the latter. A close relationship was some time ago supposed to exist between the ciliate Protozoa on the one hand, and the Turbellarians on the other, especially the larvæ of the latter. On the supposed kinship between the two groups there have been built up hypotheses relating to the descent of the Metazoa. Such hypotheses have as their kernel the transition of multinucleate Protozoa into Metazoa, and have been adopted by several investigators, among whom we must mention Jehring (19) and Saville Kent (20). From the stand-point here taken, the mouth and anus of the Infusoria are homologous with the like organs in the Metazoa. Indeed, Jehring believes that the water vascular system of the latter has been derived from the contractile vesicle of the Protozoa. Looking over the whole field of embryology, we find the formation of the blastoderm in Insecta to be the process most in accord with this hypothesis. It is, in fact, on the first stages in the development of the Aphides that Kent mainly rests his belief. Considerations of this kind clearly show that such a hypothesis cannot be maintained. While ignoring all the embryological facts of the lowest Metazoa, the theory harmonizes with the formation of the blastoderm in the Insecta; that is, in a group which has suffered in every respect great secondary changes. But even in this group there are forms that contradict the hypothesis, as, for example, the Poduridæ, insects which in other respects occupy the lowest position in the class, and agree in the segmentation of the egg with Myriapods. When the facts are these, no value can be ascribed to the homologies drawn between the mouth, anus, and water vascular system of the Infusoria and Metazoa.

On the other hand, the hypothesis which supposes that colonies of flagellate Infusoria were transformed into primitive Metazoa explains very clearly the most important phenomena of metazoan development. On this view the segmentation of the egg, and especially the more primitive total segmentation, has been derived from the division which the Flagellata undergoes in building up a colony. In like manner the fact that the cells of so many blastospheres are ciliated is probably due to inheritance from the Flagellata. This hypothesis forbids our homologizing the mouth and other "organs" of the Protozoa with the like parts of the Metazoa, but on the other hand enables us, as Bütschli (21) first pointed out, to comprehend the origin of sexual multiplication. As a fact most embryologists, Ray Lankester and Balfour among others, have adopted this second hypothesis, and after a prolonged trial it has become a basis for further speculations.

Having progressed this far, we should ask ourselves whether it is not possible, with the help of our present knowledge, to determine more or less exactly the nature of those Flagellate colonies from which the Metazoa are descended. Bütschli (22) believes the Metazoa have had a double origin,—the Sponges he derives from colonies of the Choano-Flagellata, the rest of the Metazoa from colonies of true Flagellata. Aside from the fact that there is very little ground for such a venturesome assumption, we must remember that the two groups (of Flagellata) are not sharply separated, and that the collar, which constitutes the main point of difference, is in some cases entirely retracted. As to the relationship of the Sponges to the Cœlenterates, I shall have a word to say farther on.

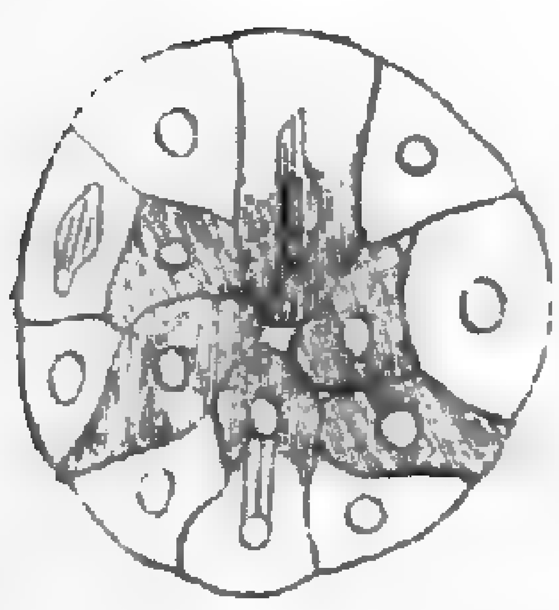
Whether the Flagellata from which the Metazoa are descended had a collar or not, they were certainly able to take in solid bits of food. This is to be inferred from the great prevalence of intracellular digestion among the lower Metazoa. Taking into account this characteristic of the Metazoa-Flagellata, I cannot believe with Bütschli that the process of nutrition is not worth considering in connection with the question of the metazoan descent. Bütschli is of this mind "because the physiology of nutrition varies exceedingly in the group of Flagellata, without regard to the morphology" ("Remarks on the Gastræa Theory," p. 417). I believe, on the contrary, that the further differentiations undergone by the ancestral colonies were by no means independent of the method of nutrition. While in some colonies vegetable pigments were found to assist the process of assimilation, others, retaining the method of animal nutrition, gave rise to individuals whose special function it was to seize and digest food. That this conclusion is not purely deductive is gathered from a comparison of such Flagellate colonies as the Volvocineæ and Protospongia.

It would be much to the interest of further deductions if we possessed some actual knowledge of the development of these hypothetical colonies. That they must have been propagated sexually is clear from the multiplication of Volvox. Indeed, the existence of sexual multiplication is a strong argument in favor of the descent of the Metazoa from the Flagellata. As regards a sexual multiplication, the existing Flagellata divide and exhibit some variety in their division. The true Flagellata divide for the most part longitudinally, but transverse division occurs in some species, for example in *Phalansterium consociatum* according to Cienkowsky (24), and in *Ph. digitatum* according to Stein (25). In the Choano-Flagellata, also, both kinds of division have been observed, even in closely-related forms. Thus, according to Kent, *Salpingœca campanula* suffers longitudinal division (20), while all the other species of this genus divide transversely. "The simultaneous occurrence of longitudinal and transverse division in one and the same form has, however, been hitherto established only for certain Chlamydomonadinæ (23). Since in animals that build up colonies the division of the individual plays an important part in determining the shape of the stock, it is important to learn how the hypothetical Metazoa-Flagellata behaved in this respect. Let us recall the generalization made in the second chapter, that the first three planes of segmentation lie in the three dimensions of space. We found this to be true for Medusæ that suffer totally different developments (for hypogenetic as well as metagenetic Medusæ, and regardless of the various ways of forming the endoderm, etc.); and it holds for animals in general, however different they may be, that undergo total segmentation. We are therefore justified in assuming that the same kind of division prevailed among the ancestors of the Metazoa. There is the more reason for this assumption in view of the many ways in which it is possible for an embryo to be built up, of which an idea may be obtained from plants and animals with unequal segmentation. Even the formation of a blastosphere can take place without the occurrence of the typical first three divisions. Thus, in Volvox, all the divisions are meridional, the result being a plate-like embryo resembling Gonium. There is no segmentation cavity, and the blastocœle is formed by the gradual growth of the plate towards one pole (22, 23, 25). If we are to use the process of segmentation at all for genealogical purposes, the assumption adopted above seems inevitable. It is, moreover, not without the support of analogous cases in the organic world, as is learned from the divisions undergone by the Schizomycetes. Most of these forms divide transversely, but there are a few exceptions with longitudinal division, for example, a peculiarly branched species parasitic in *Daphnia pulex*, discovered and described by me as *Dendrobacterium oculatum*. Besides such bacteria where there is but one kind of division, there are others where the cells divide in two meridional planes, as in the micrococci of gonorrhœa; and yet others like Sarcina, where the divisions follow the three dimensions of space and consequently agree with the total segmentation of most Metazoa, and also with the assumed division of the hypothetical Metazoa-Flagellata. Since in the typical cases of total segmentation the segmentation cavity appears after the third division, and the embryo is very early transformed into a blastosphere, it is probable that the ancestors of the Metazoa swam about as blastosphere-like colonies.

If we accept these peculiarities of the Metazoa-Flagellata as a basis for further speculations, we are enabled, it appears to me, to throw a certain light on the origin of the primitive organs. Embryology teaches us that the endoderm is formed in very different ways among the Medusæ. In recapitulating these various methods, I have first to state that the endoderm arises either at several points of the embryo or only at one point. In the first case the origin is multipolar, in the second unipolar (in the latter the pole is always at the hinder end of the larva). The multipolar type of formation appears either (*a*) as a multipolar immigration of the cells from the surface of the blastosphere into the interior; (*b*) as a primary delamination by means of the transverse division of the cells of a blastosphere; (*c*) as a secondary delamination following upon the formation of a morula; or (*d*) as a mixed delamination, where the endoderm is in part formed by transverse division and in part by immigration. These methods of forming the endoderm are not all sharply separated; on the contrary, transitions exist between some of them. The unipolar type appears either (*a*) as an immigration of the blastula (or blastosphere) cells from the hinder end of the larva, or (*b*) as an invagination.[1]

The question is now, What is the stand-point from which a comprehensive and intelligible view may be got of these various methods of forming the endoderm, and which of the existing theories on the origin of the primitive organs is best able to explain the facts? It is at once seen that on assuming the descent of the Metazoa from multinucleate Protozoa (Infusoria, or perhaps Heliozoa and Radiolaria), we become entirely unable to explain either immigration from the surface, or primary delamination, or invagination. It is unnecessary for me to go into a detailed criti-

[1] Multipolar immigration is illustrated by Fig. 3. From various points of the blastula cells migrate into the interior; and, their number increasing, they here form a solid mass of endoderm, which is subsequently hollowed out to form the digestive cavity. This method occurs in Æginopsis (Atlas to the original paper, Plate IX.). Fig. 2 illustrates primary delamination, found in the Geryonidæ (Atlas, Plates V. and VI.). The inner ends of the blastula cells are constricted off to form the endoderm. They very soon arrange themselves in the shape of a hollow sphere, the cavity of which becomes the permanent digestive cavity. Secondary delamination is the rule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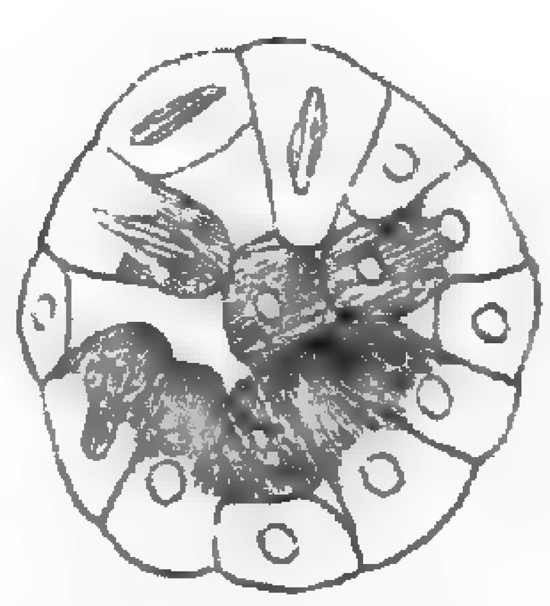
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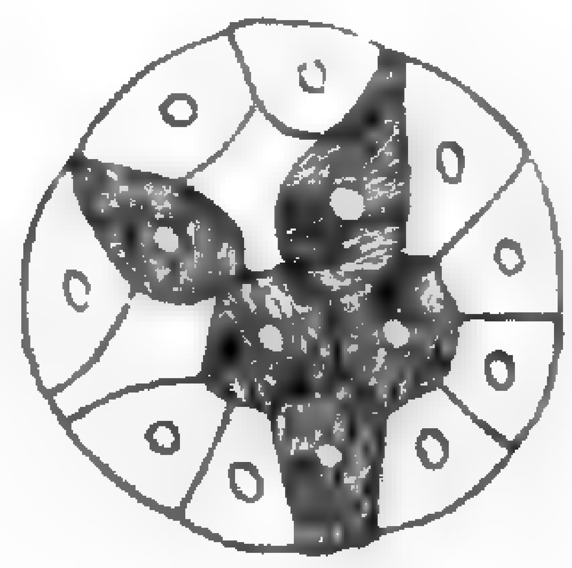
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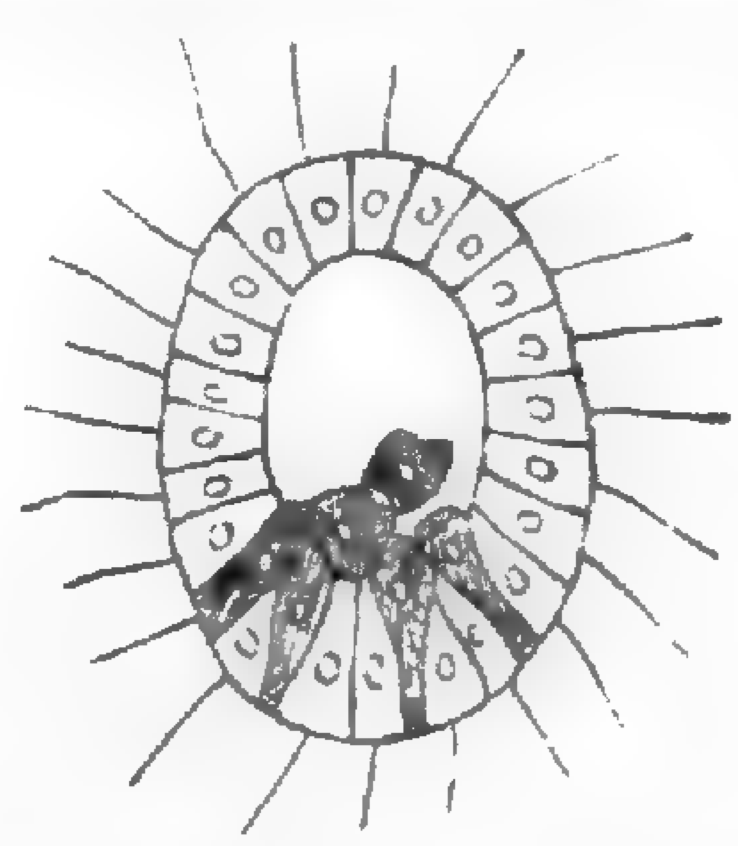
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among Hydroids without a free medusa stage. It is essentially like mixed delamination, Fig. 1, but differs from it in the very late appearance of any histological difference between the superficial layer of cells and the included or endoderm cells. Neither in this type nor in mixed delamination is there an obvious blastosphere, the cell immigration and transverse division commencing at a very early date. In both types the solid endoderm is subsequently hollowed out to form the digestive cavity. Mixed delamination is found in *Polyxenia leucostyla* (Atlas, Plate VIII.). Unipolar immigration is illustrated by Fig. 4. It is the rule with metagenetic Hydromedusæ. The immigration continues until the central cavity is filled with a solid endoderm, which afterwards is hollowed out (Atlas, Plates II., III., IV.). Invagination has hitherto only been found in the Acraspeda (Nausithoe, Pelagia, Plate X., Atlas).—*H. V. W.*

cism of this hypothesis, which can lead us nowhere, and which must therefore be rejected.

The Gastræa theory, as is well known, has rendered great service in reducing the different phenomena of development to a primary invagination; it very often simplifies the complicated appearances sometimes seen in the formation of the endoderm, for instance, in the Vertebrates. But it is when the theory is called upon to explain delamination that it finds itself in the midst of difficulties of which Haeckel was aware when he first formulated his views on this subject. "The greatest cause for doubt," said he in his monograph on the "Calcareous Sponges" (vol. i. p. 467), "seems to lie in the fact that the gastrula may come from the morula by two quite different roads. In the one case it arises by a central hollowing out of the morula, the gastric cavity thus formed breaking through to the exterior. In the other case a blastosphere is formed, a hollow sphere whose wall consists of a single layer of cells; and the gastrula results from a pushing in of one part of this wall, in other words, from an invagination." Haeckel, however, thinks it possible to overcome this difficulty by assuming a "secondary falsification of the ontogeny." In his principal paper (17) he often repeats the assertion that delamination, in case it really occurs in the animal kingdom, is a cœnogenetic process, "which has secondarily arisen from the palingenetic process of invagination." As to the way in which such a falsification came about there is no explanation offered. This is the more to be regretted, as Haeckel himself felt the difficulty his theory encountered in this matter. Haeckel and his school, the Hertwig brothers in particular, long disputed the existence of delamination, but must surely admit it now, since a member of this very school, O. Hamann (26), has lately observed the process of delamination in the Hydroids (after it had been described by several previous investigators, among whom were Allman, F. E. Schulze, and myself). Hamann, however, will recognize no difficulty in this fact, and simply declares the delaminate planula to be a gastrula which has arisen by cœnogeny from an invaginate gastrula. "Delamination," states Hamann (l. c., p. 504), "is in all cases to be derived from invagination." "In view of the elsewhere universal presence of a gastrula," says he, farther on, "the doctrine, according to which a planula is but a transformed gastrula, will remain current." And yet again, "We are justified in speaking of a form as a gastrula as soon as it can be made probable that the absence of both structures (blastosphere and gastric cavity) is of secondary origin. What we call a planula is, therefore, a gastrula formed by delamination." These assertions are made without adducing any grounds for their probability, and without making it in the least degree conceivable how invagination can be abbreviated into delamination, or what cœnogeny could effect for the origin of the latter. When one considers, moreover, that invagination is concentrated at one end of the embryo, and in the Medusæ is confined to a relatively small area of the blastoderm, while primary delamination or multipolar invagination takes place at the most various points of the embryo, it is evident that a reduction of the two latter methods to the former would meet with invincible difficulties. It is easy to understand how an invagination, originally confined to a small area, may gradually extend until, as is seen in various animals, it involves half the blastoderm. Further, one can see how a continuous layer of cells, destined to form the endoderm, may be changed into a cellular mass which is gradually enclosed by the growth of the ectoderm. But where the origin of the endoderm is an interrupted one,—that is, where the endoderm cells do not lie all together, but alternate with ectoderm cells (compare the development of Æginopsis), or where the endoderm appears as the central segments of the blastoderm cells,—it is impossible to refer the process to an abbreviated invagination. Multipolar immigration, to be sure, can be forcibly reduced to a number of invaginations, on which view each primitive gastric cavity would be represented by a single cell! It only needs to formulate such a hypothesis to demonstrate how utterly untenable it is; but, aside from this consideration, one would gain very little by accepting it, for primary delamination would still remain totally unexplained. It is between unipolar immigration and invagination that a relationship can fairly be assumed to exist, as has been maintained by Claus and others. It is impossible for me, however, without a previous discussion of other questions, to decide which form must be regarded as the more primitive.

Although its inability to explain the multipolar formation of endoderm is the weightiest objection to the Gastræa theory, it is by no means the only one. The theory was formulated at a time when the occurrence of intracellular digestion among the lower Metazoa was not known, when in fact digestion in all cases (Metazoa) was believed to be enzymatic: naturally it is now unable to answer the questions suggested by our advanced physiological knowledge. The Gastræa theory would compel us to believe that a deep gap intervened between the one-layered blastosphere and the double-walled gastrula with its digestive cavity. This very awkward gap is, however, easily filled as soon as we abandon the Gastræa theory and seek to explain the origin of the endoderm in another manner. I need not dwell here upon the difficulties encountered by supposing all the known gastrula forms to be homologous. Such matters are not directly connected with our discussion of the primitive condition of the endoderm, and besides I shall have something to say on this point in another place.

The Planula theory of Ray Lankester (27) is based on the development of the Geryonidæ, and considers the method of forming the endoderm here employed, by constricting off the inner ends of the blastosphere cells, as the primitive type. Lankester endeavors to derive invagination from a primary delamination, such as occurs in Geryonia. But even were we satisfied with this derivation, there would still remain unexplained the cases where there is no actual delamination, but where the endoderm is formed of cells which migrate from various points of the surface into the interior of the embryo. The significance of this latter origin receives additional strength from unipolar immigration, the endoderm cells in both cases being blastoderm cells, which have arisen by longitudinal division from previous blastoderm cells. Moreover, the same objection must be raised to the Planula theory as to the Gastræa theory, namely, it rests on the assumption that digestion in the lower animals is enzymatic, and herein contradicts our actual physiological knowledge. Lankester believes that the formation of a cavity into which a digestive secretion was poured preceded the formation of the endoderm. In other words, the inner segments of the blastoderm cells functioned as digestive elements while the polyplast (blastula) was still one-layered. All these assumptions become quite inadmissible when once we learn that intracellular digestion persists in many of the lower Metazoa, and is even found in some Molluscs (Phylliroë).

While the Gastræa and Planula theories start with a blastosphere composed of similar cells, Balfour (28, 29) adopts the amphiblastula as the transitional form between the Protozoa and Metazoa. I will therefore speak of his view as the Amphiblastula theory. Since it must be looked on as a modification of the Gastræa theory, it is open to the same objections as the latter. It is quite unable to explain the phenomena which occur when the endoderm does not arise as a single continuous structure, but as cells separated from one another by intervening ectoderm cells (the case of multipolar immigration especially). As regards the application of Balfour's theory to the Sponges, its untenability is shown by the fact that in many Sponges (especially Calcispongiæ and Halisarcinæ) the endoderm is a nutritive layer. This fact, already emphasized by early investigators and more than once by myself, has lately been confirmed by K. Heider (30) on *Oscarella lobularis*. The objection here raised, moreover, upsets the arguments which Balfour used to prove the isolated position of the Sponges among Metazoa.

Akin to the Amphiblastula theory is the Placula theory of Bütschli (22), not only because the latter author also believes in the separate descent of the Sponges, but because the placula in many respects may be considered as a flattened-out amphiblastula. Bütschli appreciates the weak points of other theories which deal with the genealogy of the germinal layers, and attempts in a purely diagrammatic way to construct the connection between invagination and delamination. He deduces both methods of forming the endoderm from the modification of a primary placula form. Abandoning the starting-point of other views,—the spherical colony of Flagellata,—our author adopts as his primitive form a Gonium-like one-layered plate, which for convenience I shall style proplacula. "It therefore seems fair to assume that the two layers first arose in a protozoan colony, the cells of which were arranged in one plane so as to form a one-layered plate. All the cells then divided parallel to the surface, and there thus arose a two-layered plate, the layers being probably as yet undifferentiated. To this stage of a two-layered plate we will give the name of placula." Such a placula, by assuming a sac-like form, became changed into a gastrula. In other cases the proplacula, in consequence of a secondarily retarded cell-division, gave rise to a delaminate blastosphere. As a result of these assumptions there would exist a radical difference in blastospheres, which in some cases would represent swollen-up placulæ, in others proplaculæ that have become spherical. In the development of existing animals the placula, according to Bütschli, appears as the flattened blastosphere stage found in Cucullanus (Bütschli), Rhabdonema (Götte), Lumbricus, Chiton (Kowalevsky), Phoronis, and *Ascidia mentula.* Among adult animals it is represented by *Trichoplax adhærens* F. E. Sch. But Bütschli does not perceive that the flattened blastospheres of the Metazoa just mentioned agree with his placula in external form alone, and not in any essential or morphological respect. The fundamental difference between the two lies in the fact that the two layers of the former have not been acquired by cell-division parallel to the surface, which is the essence of the placula. In Phoronis, Ascidia, and, generally speaking, in the other animals cited above, the placula-like stage is attained by the flattening of a previously more or less spherical blastosphere, and not conversely as the theory requires. According to the theory the delamination of the Geryonidæ, accomplished by a transverse division of the blastoderm cells, is a process similar to the formation of a placula or amphiblastula, such as is supposed to occur in other animals. If this be true, we should find in the formation of this so-called placula a transverse division of the blastomeres. But this is not the case. The endoderm cells of the flattened blastospheres are not split off from the ectoderm cells immediately above them, but arise by the longitudinal division of parent cells. We are thus forced to the conclusion that a placula stage does not appear in the development of existing animals endowed with a regular segmentation. There is, however, a degree of similarity between the placula and a certain stage in the development of Ctenophores, where the endoderm has the form of a plate, and is covered by an interrupted layer of ectoderm. But this stage will scarcely be looked on by any one as embodying a primitive condition, and cannot, therefore, afford any basis for a morphological generalization.

If, going farther back in the development, we regard the eight-celled embryo formed by the transverse division of the first four blastomeres as a short-lived placula, we thereby gain nothing; for we must bear in mind that the eight-celled stage of the delaminating Geryonidæ is in all respects like the same stage of the invaginating Acraspeda, and must therefore be regarded as homologous with it. If therefore the latter represents a placula, so must the former. But in this case the later delamination of the Geryonidæ, by means of transverse division of the blastosphere cells, could no longer be explained as the expression of a placula stage, because this stage would already have been passed.

Suppose, however, the assumption be correct that a placula stage occurs in the Metazoa with an invaginate gastrula. Then, since the placula theory can only explain the formation of endoderm, which takes place by means of a transverse division of the cells of a proplacula, all those cases would remain inexplicable where—the cell-division being exclusively longitudinal—the endoderm is formed by multipolar or local immigration.

According to Bütschli's theory, the blastosphere in animals that suffer delamination should be formed, as in Volvox, from a plate-like proplacula stage. He thinks, indeed (p. 423), the statements of Fol justify him in assuming the occurrence of such a stage in *Geryonia proboscidalis.* But the assumption is unwarranted, for the sixteen-celled embryo of the Geryonidæ is in itself a typical blastula, produced from an eight-celled stage precisely as in Medusæ which form their endoderm by a totally different method. The eight-celled embryo has likewise been produced by just such an equatorial division as occurs in other Medusæ and in most Metazoa with an equal segmentation. Among the latter *Sycandra raphanus*, according to F. E. Schulze's account, most nearly resembles Volvox as regards the stages preceding the blastosphere. In this sponge is found a plate-like eight-celled stage, which, however, can be of no value to the placula theory, since later on in the development there occurs an invaginate gastrula.

The morphology of the interesting *Trichoplax adhærens* F. E. Sch. (32) and its relations to the placula cannot be seriously discussed at the present time, since it is impossible to decide, with even a show of truth, what significance must be attached to the several layers of this animal. From the histological difference between the epithelial coverings of the two surfaces of the body, we cannot infer that different germinal layers were involved in the formation of these coverings, any more than in the Sponges where the same layer, the endoderm, appears in the chambers as flagellate epithelium and in the central cavity as flat epithelium (for example, in *Oscarula lobularis*, according to K. Heider). The difficulties presented by Trichoplax are heightened not only by our ignorance of the development, but by our lack of any facts from which to determine the physiological functions of the several layers of the body. Thanks to the kindness of Professors F. E. Schulze and Claus, I was enabled in 1883 to study Trichoplax both at Graz and Vienna, and to fully confirm the histological discoveries of the former investigator. My experiments on the manner in which the animal fed gave purely negative results, for it would take no solid food at all, thereby lending countenance to the view that Trichoplax depends on fluid nourishment alone.

Bütschli thinks the Placula theory is of more value from a physiological point of view than the other theories criticised by him. "Finally, it seems to me very important," says Bütschli (l. c., p. 416), "that the changes undergone by the assumed forms are easily comprehended, that they take place gradually, not by jumps, and are actually advantageous." "Especially in this latter respect," adds Bütschli, "is the new view about to be developed superior to its predecessors." When, however, it comes to explaining physiologically the origin of the placula, no satisfactory reasons are given why it should arise. "I regret that I am unable to adduce," Bütschli confesses himself (p. 419), "any plausible advantages to be gained by the plate on its becoming two-layered."

(To be concluded.)

THE ORIGIN OF A SMALL RACE OF TURKEYS.

BY JOHN DEAN CATON, LL.D.

THE effect upon the progeny of animals of inbreeding, or where the parents are nearly related, is a subject well worthy the attention of naturalists, though I am not aware that it has been the subject of careful study, especially among the lower forms of animal life.

With man it has undoubtedly received much attention, but even here it has been rather of a desultory character than that careful and systematic attention which its practical importance would seem to justify. It has received attention undoubtedly from breeders of domesticated animals, but even here, so far as I am aware, are wanting long-continued experiments and careful observation. The most that can be said is that a general impression prevails among breeders that the offspring of very near relatives is seriously impaired in constitution and form. Yet instances have been cited where for one or two generations, at least, an improvement has been observed in both of these respects, and I do not remember to have seen any statement of well-authenticated observations justifying the general impression which undoubtedly prevails among the breeders of domestic animals. With the human race the fact of such deterioration resulting from the near relationship of the parents may be considered as well established, and it may be possible from this recognized fact the conclusion has been drawn that the same causes must produce the same effects among the lower orders of animals. This is a subject in which the professional breeder no less than the professional scientist should feel a deep interest, and it is to be hoped that some of these will institute careful and long-continued experiments which may throw valuable light on this subject.

A few isolated cases would be far from conclusive, yet the result of each one would have its value. These experiments should not be confined to one species alone, but should cover the entire range of domesticated animals.

In some species an actual improvement might be the result, while in others the most disastrous consequences might be observed.

With the hope of acquiring some light on this subject, some years since I disposed of all of my elk (Wapiti deer) excepting one pair, which were three years old, and when a large herd shall have been raised from this single pair we may be able to form some opinion of the effect of interbreeding upon this species of deer. The second fawn produced from this pair was a female, and she died yeaning when two years old, and since then there has not been sufficient time for the production of the inbred progeny; but even this experiment may not be entirely satisfactory, for the Wapiti deer I have found to be the most hardy and reproductive in domestication of any of the deer family.

Ten years ago I sent a number of wild turkeys from my grounds in Ottawa to Santa Cruz Island, situate in the Pacific

Ocean about twenty miles off this coast. During my stay here this winter I have formed the acquaintance of Mr. J. P. Joyaux, who at that time had charge of the island, which was used principally as a sheepwalk. It is about thirty miles long, and five to ten miles wide. There were no enemies upon the island with which the turkeys had to contend except a small gray fox, which was quite abundant. Six turkeys were received by Mr. Joyaux, two cocks and four hens. One of the cocks died soon after their arrival. They were received in the winter. The next season the four hens raised to maturity sixty-one birds, which when grown up were as large as their parents. The year following the produce was one hundred and twenty, of about the same size. I may here remark that the wild turkeys in my grounds at Ottawa, which have been hatched from eggs taken from the nest of the wild hen in the woods, have never bred till they were two years old, but some of the first generation raised in the grounds have bred when a year old, and generally the second or third generation have reproduced at a year old. Probably, therefore, not all of the hens of the first year's brood bred the next year, and this may account for the smaller relative product the second year than the first, and it is possible, and even probable, also, that Mr. Joyaux was unable to enumerate all of the second year's produce. After that they had wandered away and reverted to the wild state, so that it was impossible to form any opinion of the increase, only that they have become very abundant, and are met with in the forests far away from the ranch where the first were turned loose, and if they are not as wild as the wild turkey is observed to be in his original haunts, it may be attributed to the fact that they are not hunted with dog and gun.

In a very few years these birds bred upon the island were observed to have diminished very much in size, so that now it would be impossible to find a cock which would weigh over six pounds, which is less than one-third the size of their original ancestor or of the first and second generation bred there.

Mr. Joyaux attributes this remarkable deterioration in size to inbreeding. He says their food is abundant, consisting of small acorns, a great variety of berries, an abundance of insects, and plenty of grass. While they do not get our domesticated grains, they find plenty of seeds of grasses and herbaceous plants in their season, and plenty of water everywhere.

This is undoubtedly a case of pretty close inbreeding, the entire stock having descended from one male and four female ancestors. While I do not consider it conclusively established by any means that this deterioration in size should be attributed solely to inbreeding, it is not unlikely that this cause may have had its influence; nor am I prepared to assign any other satisfactory cause for this remarkable result. Although the native wild turkey was never found on the west side of the Colorado, while it was abundant in Arizona, not far east of that river, there would seem to be nothing in the condition of this country especially detrimental to their well-being here. The wild turkey which I have introduced in various places on the mainland north of San Francisco are reported to have done well. They are said to be prolific and healthy and to attain their normal size; and the domestic turkey, which is found all over the State, is said to do fairly well, although upon the table they are not as much admired as those raised in the Eastern States, nor are they in general as large or as fat.

No epidemic has been observed among the turkeys on Santa Cruz Island; but, on the contrary, they seem to have been always healthy and vigorous. Their habit of flight as represented to me is about the same as that observed of the Eastern wild birds in their native haunts. The flesh of these small birds is said to be good.

I have been thus particular in my account of the introduction of the wild turkey upon the island of Santa Cruz because I think it entitled to some weight at least in the investigation of the question which I have suggested.

It may be impossible to obtain facts which can throw much light upon the effects of inbreeding among wild animals in their unrestrained condition, especially those of monogamic or promiscuous habits, which is the case with most wild animals. Among quadrupeds where two are usually produced at a birth, so far as observed, the twins are usually male and female, and most probably they continue together in close intimacy till they attain a reproductive age; and here we might reasonably expect that inbreeding would very often occur, and yet there may be conditions which would disappoint this expectation, such as, for instance, the older males in the forest driving off the younger. In the case of quadrupeds where several are produced at a birth, we might expect that inbreeding might still more frequently occur, but, after all, it is only where animals are subjected to the control of man that it is possible to make observations which can give us any satisfactory results upon this subject; so that, as before suggested, our only hope for reliable information on this subject must rest with the breeders of domestic animals. Should they take interest enough in it to make careful and numerous and long-continued experiments with the various species of animals under their control, something like certainty might be obtained where we have now nothing better than conjecture.

Santa Barbara, Cal., February 24, 1887.

SONNETS.

CACTUS.

(Prickly Pear.)

I KNOW an isle, clasped in the Sea's strong arms,
Sport of his rage and sharer of his dreams;
A barren spot to alien eyes it seems,
But for its own it wears unfading charms.
From Spring's first kiss to Autumn's last caress,
Gayly its moorlands bloom, from strand to strand;
And many a favored nook, by west winds fanned,
Holds flowers unmatched for tint and loveliness.
But most I mind me of a lonesome shore,
For countless gulls a harbor and freehold,
Where, like some shipwreck'd buccaneer of old,—
Cast on the sands, condemned to rove no more,—
In spiny armature, secure and bold,
The Cactus lies at length and guards its gold.

Nantucket, July.

Note.—The island of Nantucket is the northern limit of *Opuntia vulgaris*.

PARNASSIA.

(Grass of Parnassus.)

Oh, stately, calm, and pure, as best beseems
One born in that far land of sun and song,
Beloved of gods and men, whose vales along

Strayed once the sacred Nine, and by whose streams
The great Pan piped;—remote and strange it seems
To find thee here, 'mid grasses rank and long,
Where, by the hidden brook, serene and strong
As Autumn's smile, our clear-eyed Gentian gleams.
Perchance it was her blue and fringéd eyes
That lured thee from thy storied home to range,
And tempted thee to give, in glad exchange
For such a heaven, thy classic Grecian skies:
It well may be, since beauty knows no clime,
And love, immortal, conquers space and time.

October.

WITCH-HAZEL.

What time the dainty darlings of the Spring,
Summer's ripe beauties, Autumn's brilliant train,
In swift procession trooped o'er hill and plain,
Thro' vale and grove, while every bird did sing
His fitting song;—we took no note of thee,
O arch enchantress of stream-haunted woods,
Waving aloft thy flowerless magic rods,
And whispering to the winds their mystery!
But when the merry carnival is o'er,
The banners furled, the gay robes laid away,
Thou shinest forth in marvellous array,
Charming our thoughts from all that passed before.
Is it to witch old Winter with thy wiles,
This burst of golden hair and sun-bright smiles?

Emily Shaw Forman.

November.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

THE judicial attitude in all things is, in the present stage of human development, a far from common accomplishment. Philosophy, however, requires it, and scientific men should be, if possible, philosophers. But it is precisely this class whose philosophy is most frequently put to the test by their fellow-men. To a majority of the human race the intellectual life is a shadow not worth pursuing, and those who pursue it are correspondingly disesteemed by them. The defect of the intellectual type of mentality in a community is a stage of development which is the parent of better things or worse things. From it may arise a society of philosophers, or of religious devotees, or of Heliogabali and Vitellii. That the type of face that characterized the last of the imperial family of Rome is appearing in our streets is quite evident, and it will require the exertions of the devotional and intellectual classes to prevent it from becoming still more common. That Brother Jonathan should come to resemble a Nero would be an unexpected metamorphosis; yet signs are not wanting that such a degenerative process is not impossible. The unintellectual materialism which characterizes the majority of the wealthy classes of Americans will be watched with serious curiosity. Some of the wealthy will direct their stored energy to the improvement of their race; others will expend it in degenerative processes. Which type will prevail?

The excellent services of the religious world in directing human activity away from destructive channels should be perceived and sustained by the scientific community. Nevertheless, it cannot but be lamented that the work of the churches is often more profitably directed to instructing the people as to what they should *not* do, and not sufficiently clearly as to what they *should* do. It is in the latter direction that weakness is often apparent. Nevertheless, the influence of the churches in this direction also is of incalculable benefit.

It rests with the scientific world to bring out the facts of the universe, or, in other words, the truth. And knowledge of the truth is the only safe guide as to what men shall do and what they shall not do. But this service does not furnish energy.

It offers only light. Light may be refulgent, and men may "love darkness rather than light." So the office of supplying to men the energy to act will never be an unimportant one. But let that energy be applied in the direction of light, and not in any other way. It is the disposition to set ancient dogma over modern light that furnishes the *raison d'être* of the odium antitheologicum. The enlightened mind revolts against this tyranny over intelligence, and excuses for its authors are not always at hand. Let science, however, avoid bigotry on her side, and she will gain by the contrast. She can afford to be judicial, remembering that the earlier stages of human as of lower evolution are all about us, and that they furnish plastic material ready to her hand.

RECENT LITERATURE.

Strasburger and Hillhouse's Practical Botany.[1]—Some time ago we noticed briefly the original German edition of this book, which appeared under the name "Das Kleine Botanische Practicum." We now repeat our conviction of its great value to the beginner, and trust that it will be widely used in this country. The additions made by the author and English editor have added greatly to its usefulness.

Throughout the work much attention is given to the instruments and apparatus used in investigation, the work differing in this respect from any others of its kind. The authors do not think it trifling to give particular directions as to the cleaning of cover-glasses, the placing of a drop of water upon the slide, etc. A dozen pages are devoted to instruments, reagents, etc., and then the student "learns to do by doing." Studies of starch, aleurone, protoplasm, chromatophores, tissues, bundles, etc., follow one another in succession, the student being thus led over the field of general histology, after which he takes up in order the study of selected examples of the lower plants, the Bacteria, Algæ, Fungi, Lichens, Mosses, Liverworts, Vascular Cryptogams, finally reaching the Gymnosperms and Angiosperms.

A valuable feature of this edition consists of the lists of "ma-

[1] "Handbook of Practical Botany," for the botanical laboratory and private student, by E. Strasburger, Professor of Botany in the University of Bonn, author of "Zellbildung und Zelltheilung," etc. Edited from the German by W. Hillhouse, M.A., F.L.S., Professor of Botany and Vegetable Physiology Mason Science College, Birmingham, formerly scholar of Trinity College, and Lecturer in the University of Cambridge. Revised by the author, and with many notes by author and editor. With one hundred and sixteen original and eighteen additional illustrations. London: Swan, Sonneschein, Lowrey & Co., Paternoster Square, 1887.

terial wanted" placed at the head of each chapter. In the appendix are to be found a list of plants and parts of plants used for study and a list of the reagents necessary, with directions for their preparation and use.

We cannot refrain from quoting a few sentences here and there from the book. In speaking of microscopes, the translator remarks, "As the English student will probably purchase a microscope of home manufacture, it is desirable to state here that the larger and typically English stands are not to be recommended for student use. Their length of body makes it exceedingly difficult to use them upright without a special table; and the upright position is, all round, the more convenient for student work. Nor are mechanical appliances for moving the object-slide about on the stage of utility commensurate with their cost and the want of independence which they induce. Most of the English makers manufacture microscopes with tubes of about the 'Continental' length, but of better workmanship than the ordinary 'student' stands, and suited for the addition of accessory illuminating and other appliances." In another place, when speaking of the "rack and pinion" adjustment, the translator says, "It is, however, of doubtful advantage to the learner."

The objectives recommended are three-quarter and one-sixth inch. Razors, forceps, dissecting scissors ("for which fine embroidery scissors will serve"), needle-holders and needles, scalpels, small brushes, "a small vise, such as used by watchmakers," pipettes, glass tubes and rods, watch-glasses and glass disks for covering them, bell-jars and zinc frames for moist chambers, bell-jars for the microscopes, elder pith, "a tumbler of clean spring water," and a saucer for dirty slides, are enumerated as the necessary apparatus upon the table.

It remains to be said that the English publishers have done their work well; the print, paper, and binding are just what they should be for a laboratory manual.—*Charles E. Bessey.*

RECENT BOOKS AND PAMPHLETS.

Gage, S. H.—Notes on Microscopical Methods. Ithaca, 1887. From the author.

Mineral Resources of the United States for the Year 1885. Washington, 1886. From the U. S. Geological Survey.

Stowell, T. B.—The Facial Nerve of the Domestic Cat. Ext. Amer. Philos. Soc., Nov. 5, 1886. From the author.

Taylor, H. C., Horsford, E. N., et al.—Bulletin of the Amer. Geog. Soc., 1885, 1886.

Hennessy, H.—On the Physical Structure of the Earth. Ext. Philos. Mag., Sept. 1886. From the author.

Lydekker, R.—Catalogue of the Fossil Mammalia in the British Museum. Part IV., 1886. Ungulata, suborder Proboscidia. From the author.

Errara, L.—Une expérience sur l'ascension de la sève chez les plantes, 1886. From the author.

Nehring, A.—Ueber die Nahrung unserer Robben-Arten. Ext. Deutsche Jäger-Zeitung, July, 1886. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

America. THE MUIR GLACIER.—The Muir Glacier, which presents a front of one mile to an inlet at the head of Glacier Bay, Alaska (58° 50′ N. 136° 40′ W.), has been investigated by Mr. G. F. Wright. Near the mouth of the bay is a cluster of low islands, evidently formed of glacial débris, and forested. The islands and shores in the upper part of the bay are devoid of forest. The mountains east and west of Muir Inlet are respectively two thousand nine hundred and three thousand one hundred and fifty feet high. Between these mountains the glacier is ten thousand six hundred and sixty-four feet wide. The angle of ice projects into water five hundred and sixteen feet deep, and is itself two hundred and fifty feet high. The surface of the ice rises to the east and north about one hundred feet to the mile. The main body of the glacier occupies a vast amphitheatre, with diameters ranging from thirty to forty miles. Nine main streams unite to form the grand trunk, and seventeen sub-branches can be seen. Rocky eminences rising above the surface are smoothed and scored and have glacial débris upon them, showing that, like the islands in the bay, they have been recently covered by ice. On the side from which the ice approached these islands it is several hundred feet higher than on the lee side. The ice in the eastern half of the amphitheatre is moving much more slowly than that in the western half. Much water runs below, and here and there there are superficial streams which eventually plunge downward through the ice. The front is perpetually breaking off, and Mr. Wright calculates that in August one hundred and forty million cubic feet enter the water daily, since the whole mile of width and seven hundred feet of depth move on at a

[1] Edited by W. N. LOCKINGTON, Philadelphia.

rate of forty feet per day. Evidences of the recession and diminution of this glacier are numerous.

AMERICAN NOTES.—Dr. Ten Kate has completed his explorations in Surinam, during which he visited the valley and grotto of the Guacharo, and has returned to Holland.

Mount St. Elias is, according to Mr. Seton Karr, not less than three miles east of the 141st meridian, and is thus in Canadian territory. The area of the Agassiz and Guyot Glaciers is estimated at not less than eighteen hundred square miles, but the Tyndall Glacier, issuing from the southwest face of the mountain, is the principal. Mr. Karr ascended one thousand feet higher than Lieutenant Schwatka. He thinks that the Jones River is produced by the melting of the glaciers, as he saw no break in the chain.

Africa. THE GERMAN AFRICAN ASSOCIATION.—Count Pfeil has made two important journeys for the German East African Association. On the first, after traversing the district of Makata, he entered that of Khutu, which has been acquired by the Association. The second journey was principally occupied by the exploration of the Ulanga River, which he ascended for one hundred and fifty miles to 35° 5′ E. long. and 9° 5′ S. lat. Below the Sugali Falls the river is known as the Rufiji. From Ngahoma towards its source in the mountains, northeast of Lake Nyassa, the direction of the river is first west and then southwest. The depth of its lower course varies from ten to more than twenty feet.

DR. LENZ'S JOURNEY.—Dr. Lenz reports great changes upon the Congo in the upper cataract region. The natives have to a great extent retreated from the river, and their place is occupied by trading settlements of Africans and Zanzibaris. Kibonge, two days above the last cataract, has some hundreds of homesteads and a few thousand inhabitants. Riba-Riba, named after its founder, a Mohammedan negro from Nyangwe, is also a large settlement. There are now enormous rice-fields in this region. Nyangwe is now less important as a trading-place than Kasonge, Tippoo Tip's headquarters, a few days to the southeast. The whole of the region is in the hands of the Arab traders and their dependents. Said Mohammed Kasuenda is Tippoo Tip's friendly rival.

DR. FISCHER'S LAST JOURNEY.—The late Dr. G. A. Fischer's journey in Eastern Equatorial Africa, though it failed in its main object, has added much valuable information respecting the east coast of Lake Victoria Nyanza. On his way out from Pangani, through Uwerewere, he ascertained that the Muara (Stanley's Liwumba) does not join the Simiu, but loses itself in the plains, or, in the wet season, in a lake. Rounding Speke Gulf, the party entered the sparsely-wooded country of Shashi, with mountains five thousand feet high and an agricultural people. Kawirondo was crossed, and progress north was stopped by want of food at Ulala, the capital of Njoro. Returning, Thomson's route was followed by Lake Bavingo to Lake Naivasha. Here the party struck across the highlands of Kinangop, crossed the Aberdane range at a height of eight thousand nine hundred feet, marched through the thickly populated and richly cultivated district of Kikuyu, and, turning southwest, passed through the district of Ulu, along the east of the Ulu range, across the head-waters of the Ssabaki, and *via* Kissigau to Wanga, on the coast.

African Notes.—Dr. Junker reached Zanzibar December 11. On a late journey he followed the Welle-Makua to 22° E., only one hundred and fifty miles from the point upon the Mobangi reached by Mr. Grenfell.

Mr. J. A. Wray has reached the water-edge of the picturesque crater lake Chala, on Mount Kilimanjaro. There is but one spot, on the west side, where this small lake, which is surrounded by wooded banks one thousand feet high, can be reached. The water is clear, cool, and sweet, there is no mark of higher water, and no apparent inlet or outlet.

A monthly mail has been established between Zanzibar and the stations of the London Missionary Society on Lake Tanganyika.

Dr. Rousjie believes that he has been able to identify all the peaks of Central Tunis mentioned by Ptolemy and to confirm his hydrography.

Mr. J. T. Last has travelled from Blantyre to the Namuli Hills, traversing a district before unknown to Europeans. Lake Limbi is a long, narrow pool, forming the head-waters of the Sombani River.

It is said that Tippoo Tip has given in his adhesion to the Congo Free State and regrets the taking of the Falls Station, which occurred during his absence. Mr. Stanley was accompanied from Zanzibar to the Congo by Tippoo Tip, and expects the restoration of the falls through time. *Nature* states that upon his arrival at Stanley Falls with the first contingent of about two hundred and fifty of his men, Stanley will at once proceed to Emin Bey, taking with him probably a reinforcement from Tippoo Tip.

Asia. The Dragon Lake.—According to Buddhist cosmogony, the four rivers of Paradise issue from the Dragon Lake of Central Asia. Hwang-Tsang, a Chinese traveller of the seventh century, visited this lake, and it appears that it is identical with Lake Rang-Kul, recently visited by Mr. Ney Elias in his journey across the Pamir from Yengi-hissar to Shignan. This is, at least, the opinion of Sir H. Rawlinson. The banks of the lake are encrusted with salts, yet the waters are sweet. A tributary of the Murghab seems to communicate with the lake by an underground channel, but the Kashgar River does not, as was stated by Hwang-Tsang, communicate with the lake. It is said to be presided over by a dragon, who is supposed to guard immense treasures and to reside in a cave near the summit of Cheragh-Tash, or "lamp-rock," a rock about one hundred feet high near the water's edge. A light, probably phosphorescent, burns in this cave, and is said to be the sparkle of the diamond in the dragon's forehead.

Japan.—The very interesting account of the physical geography of Japan, with remarks upon its people, contributed by Dr. E. Naumann, who has had in charge the geological survey of Japan, is itself too condensed to be capable of satisfactory condensation. Dr. Naumann states that the Japanese islands are the most elevated portions of an enormous chain of mountains, the height of which must be measured by adding the depth of the Tuscavera basin to the altitude of Fujinoyama (12,425 feet). These mountains are a vast earth-wave, the advanced frontier of Asia, igneous but not volcanic, since volcanoes play a very humble part, and fossils of the remotest periods are met with. The "Radiolarian slate" is Palæozoic. The angle of descent of the ocean-bed is about 3°. The Japanese chain consists of a long series of folds, running, as a rule, in the same direction as the chain, but towards the northeastward curving hook-like towards the Japan Sea. West of Tokio is a great transversal cleft or fissure in which several volcanoes, including Fujinoyama, have sprung up. The folds seem to have advanced from the Sea of Japan towards the ocean, but the great fissure resulted from their encounter with another chain stretching from Tokio Bay to the Bonin Islands. Dr. Naumann writes as one enchanted by the beauty of Japanese scenery, and has much admiration for the people, though his estimate of the Japanese house is more matter-of-fact than that of Professor Morse. Farmhouses have a hole for the smoke of the fire to escape, as was the case in England in Saxon times and later, and even rich Japanese feel at home in small and perishable structures.

Afghanistan.—Afghanistan is still so far an unknown country that Captains Maitland and Talbot found a well-defined elevated tract filling up the whole space between the Hindu-Kush and the high mountains about the sources of the Hari-rud and Murghab. This range runs east and west at a distance of from five to twelve miles from the towns of Tashkurgan, Mazar-i-sharif (now the capital of Afghan Turkestan), and Balkh. It is hardly indicated on any map, and is not mentioned by previous travellers. The Hazanahs are a simple, good-natured people.

Asiatic Notes.—M. Tchersky has published at St. Petersburg a geological map of the borders of Lake Baikal.

The Russian Geographical Society has appointed a committee to make more thorough investigations into the subject of the desiccation of the Siberian lakes.

The river Kara-ssu, near Lake Balkash, marked on existing maps, does not exist, and the streams of the At-Lessken range have long been dry. The water of the river Ili is being diverted to the eastern arms of the delta, while the western channels have become mere pools of standing water. The water in the main stream has not overflowed for three years, while the Kurli arm of the delta is becoming filled.

A new glacier called the Mushkelof, discovered in the Khan-Tengri group, exceeds in size the well-known Ssmenof Glacier.

Dr. Bunge and Baron von Toll have succeeded in their attempt to reach the New Siberian Islands. The former explored Ljachow, the latter Kotelny. Earlier the two explored five other islands. They returned to the mainland in October last.

Major Macgregor has contributed to the *Proc. Zool. Soc.* an account of Colonel Woodthorpe's expedition to the Irawadi. The ruling race in the district is that of the Buddistic Kamptis, who are Shans, and do not exceed twelve thousand in number. Their dress resembles that of the Scotch Highlands. The other races are the Singphos or Kakhyens, who are Thibeto-Burman by race but are spirit-worshippers, the Mishmis, a small, active, dirty race of Mongolian type, and the Nagas, who are miserably poor and almost without clothing.

Australia and Oceanica. The New Britain Group.—In the January issue of the *Proc. Roy. Geog. Soc.* Mr. H. H. Romelly gives an account of New Britain and New Ireland, or, as the Germans now style them, New Mecklenburg and New Pommern, as they were in 1881–1883, at which date the white population consisted chiefly of roughs and runaways. The two most conspicuous objects on approaching New Britain are the conical mountain named Mount Beautemps Beaupre and an extinct volcano named The Mother. The latter shelters the harbor of Blanche Bay, which is surrounded by volcanoes, some still active. Vegetation is most luxuriant, and the forest-trees are covered with ferns, orchids, and lycopods. The natives are good agriculturists, making the most possible of the almost inaccessible spot to which mutual hostility compels them to resort. Our authority places the native population of New Britain at one hundred thousand, that of New Ireland at half that number. The former island has numerous small rivers, while the latter seems to have none worthy of the name. Good harbors have recently been discovered at the northwest end of New Ireland, and German traders are now stationed there. New Hanover, a large island northwest of New Ireland, has many rivers, fertile valleys, and wide-spreading plains sloping up to the high interior, but the natives are uncompromisingly hostile.

In New Britain betrothals take place at a very early age, but a high price is fixed on the girl, so that the man is often middle-aged before he can marry her. He may get impatient and elope, but in that case dare not return to his tribe. But elopement usually takes place when the price is nearly paid. The couple build a house in the bush; both families assemble, vow vengeance, paint as if for war, and sally forth and burn the house, from which the culprits are absent; the couple come back to the village in the morning, and the rest of the money is eventually paid. The curious point is that if after all the waiting the woman will not live with the man he cannot recover the property he has given to her parents.

The writer describes in detail the ceremony of the duk-duk, who is supposed to be a spirit who appears at the break of the day of a new moon. Men covered with a tunic and a very high hat personate the duk-duk and irritate the young men with blows of cane and club. Cannibalism—at least in the form of eating enemies killed in battle—still exists in these islands.

The Rev. George Brown, a Wesleyan missionary long resident in Duke of York Island, between New Britain and New Ireland, confirmed the charge of cannibalism, stating that when on one occasion he adventurously crossed New Ireland he saw at one house thirty-five human jaw-bones, some just picked, hanging on a rafter. The west coast of New Ireland was very well watered, and had large rivers. The standard of value among the people is six feet of strung shells, and the natives have words signifying "buy," "sell," "borrow," "lend," and "redeeming" a pledge, lend money at ten per cent., and have a word equivalent to "selling at a sacrifice."

New Guinea.—The Rev. I. Chalmers's account of his journeys in New Guinea (*Proc. Geog. Soc.*, February, 1887) contains, like all accounts of journeys in this region, far more ethnographical than geographical information. In 1878 Mr. Chalmers and his wife visited the whole coast from China Strait to Hall Sound; after this he went inland from Catamaran Bay to Discovery Bay, and he made several inland trips from Port Moresby. He also voyaged in a native "lakatoi," made of three dugouts lashed together, from Port Moresby westward to the Annie River, visiting the cannibal district of Namau, and becoming so extremely friendly with the cannibals that the wonder was that they did not eat him for sheer love of him. Mr. Chalmers jests about the "skullery,"—an open space near the dubu, or temple, provided with pins to hang skulls on. The skulls were all carved and gayly colored. The dubu was nearly two hundred feet long and about eighty feet high to the peak in front, where there was a large veranda, but diminished to nine feet at the back. The aisle, hung with curtains of the frond of the young sago-palm, had a floor polished with blood and the tread of feet.

Inside there were six wicker gods with enormous frog-mouths and dugong-like bodies.

The Empress Augusta River, in German New Guinea, has been navigated for two hundred and twenty-four miles by Admiral von Schleinitz in the "Ottilie." The steam-launch proceeded one hundred and twelve miles farther, and returned from want of fuel. This was in the dry season.

GEOLOGY AND PALÆONTOLOGY.

Hummocks and Boulders of Decomposition in Southeastern Missouri.—Among the crystalline hills of Southeastern Missouri boulders of decomposition are frequently seen. In fact, it was owing to a small eminence—two hundred feet above the ancient broad Cambrian valley—being covered with detached boulders of iron ores that the name Iron Mountain derives its origin. From its surface it is said that seventeen million tons of iron boulders have been taken, these having been left behind by the removal, during long ages, of the intervening decomposed feldspathic rocks. Throughout the region the surfaces of the crystalline rocks are covered with their decayed remains to a depth from a few feet to fifty or seventy-five feet.

The rocks to which attention is here called are those of a knob, about five miles from Iron Mountain, rising out of a broad valley, where the quarries of Graniteville are situated, at an elevation above the sea of about twelve hundred feet, south of latitude 38° N.

The surface of the red granulite is commonly covered by its own material decomposed *in situ* to a depth of only a few feet. The decay is not always gradual from the surface inward, but frequently *per saltum*, leaving hard surfaces immediately below the more or less decomposed materials. But over an area of several acres these rocks are not covered with earthy matter. Here may be seen perfectly rounded or ellipsoid hummocks from twenty feet or less in width to forty or even one hundred feet. Some of the ridges are unbroken for a length of several hundred feet, while others are made up of a chain of hummocks, whose general trend as well as slope is southwest,—the same direction as that of the prevailing, but not numerous, joints shown in the adjacent quarries. Some of the parallel ridges or chains have flat, rounded surfaces, thus, ⌒‿⌒‿⌒‿⌒, whilst others are like inverted U's, separated by narrow furrows from one foot to five feet or more in width, and from ten to twenty feet deep, thus, ∩∩∩∩, which represent deep weathering and removal along the lines of joints. These hummocks have perfectly the form of typical *roches moutonnées*—less only the frequent, although generally superficial, scratches—of modern glacier regions. In many places, upon what we may call the *roches moutonnées* of Graniteville, there are boulders, more or less rounded, still fitting into their original places, although the decayed connecting rocky matter has long since been removed. Most of the boulders have spheroidal or ellipsoidal forms, and resemble as much northern erratics, or perched blocks, as any seen within the drift zone of America or modern glacier regions of Europe. One of these boulders is about thirty feet long, fifteen feet broad, and twenty feet high, perched on top of a rounded hummock, and resting on only a few small points.

When one compares the forms of these rocks south of the line of northern drift, and of others similar in the more southern Appalachians, and reads of the same in warm countries, as Ceylon and Brazil on the one hand, and, on the other, with those of the Swiss valleys and the greater and more wide-spread rounded surfaces of Norway, still in contact with living glaciers, —where he may see how unimportant a factor is the land-ice in gnawing away the old crystalline rocks,—one is forced to look upon the structure of both as more or less of common origin,—atmospheric erosion, perhaps aided by currents,—although the latter region has been swept off by a brush of ice which has left scratches behind.—*J. W. Spencer, University of Missouri, Columbia, Mo.*

The Dinosaurian Genus Cœlurus.—This genus was described by Marsh, in 1871,[1] from material obtained in the Jurassic deposit of Wyoming Territory. Characteristic bones not distinguishable as to genus from those described by Marsh are in my collection from New Mexico, probably from beds of Triassic age. They consist of nearly all parts of the skeleton, excepting jaws and teeth, and but little of the skull is determinable. The material is much more complete than that described by Marsh.

The remains show that the genus Cœlurus is a Dinosaurian, and I cannot agree with Professor Marsh's view "that Cœlurus cannot be placed in any known order."[2] The ilium has the general character of that of the carnivorous suborder (Goniopoda), and the other parts of the skeleton confirm this reference. Such is the possession of compressed, strongly-curved claws, which were capable of very extensive flexion and extension. Cœlurus is in fact allied to Megadactylus (Hitchcock) from the Trias of Massachusetts, differing principally, so far as determinable, in the form of the condyles of the femur. They are simple in Cœlurus, but in Megadactylus the external condyle has the double character seen in Megalosaurus.[3]

The vertebræ are all of slender proportions, especially those of the neck and tail. These, with most of the bones of the

[1] Amer. Journal Sci. Arts, p. 339, Plate X. [2] L. c., p. 340.
[3] See Cope, Trans. Amer. Philosoph. Soc., xiv., 1870, Plate XIII.

limbs, are hollow, having large central cavities surrounded by thin walls, as in Megadactylus. There are four sacral vertebræ. The phalanges are elongate. The anterior caudal vertebræ only have chevron bones. These have escaped Professor Marsh, who says they are wanting; but he does not appear to have possessed the most anterior of the series. In neither species is there a distinct third trochanter of the femur, but there is, not far below the great trochanter on the anterior face, a low, longitudinal, ridge-like angle. The femoral condyles have but little anteroposterior extent, which implies but little flexure of the knee. The humerus is a good deal smaller than the femur, but the disproportion is not so great as in Lælaps.

The form seems to have been that of a terrestrial reptile which walked readily on the hind legs, and was probably a great leaper. The extremely long neck is a striking peculiarity, giving proportions to the body about like those of the swan. The habits were probably predaceous and carnivorous.

Two species are indicated by my collections, as follows:

Cœlurus longicollis. Cervical vertebræ one-third longer than those of *C. fragilis* Marsh; the sides of the centrum not sulcate; the anterior articular face of an anterior centrum not convex. The faces are oblique, showing that the head was carried above the level of the body. The caudal vertebræ were all quite slender, indicating the length of the tail.

Length of body of cervical vertebra		.063
Diameters of posterior cup	vertical	.016
	transverse	.019
Length of centrum of dorsal vertebra		.042
Diameters of posterior face	vertical	.020
	transverse	.021
Length of caudal centrum		.051
Diameters of posterior face	vertical	.023
	transverse	.021
Length of femur		.215
Diameters of condyles	antero-posterior	.024
	transverse	.030

This reptile was about the size of a greyhound.

Cœlurus bauri.[1] In this species the sides of the cervical centra are deeply and widely grooved on the posterior half, and the superior face of the neural arch is strongly grooved on each side on the anterior half. The size is much inferior to that of the *C. longicollis*. The femur is not so strongly grooved at the third trochanteric ridge.

Diameters of cervical centrum behind	vertical	.0115
	transverse	.013
Length of sacrum		.073
Diameters of anterior sacral centrum in front	vertical	.014
	transverse	.015
Transverse diameter of femoral condyles		.022

[1] Dedicated to Dr. George Baur, the distinguished comparative anatomist of New Haven.

The horizon from which these species were obtained is probably upper Trias. It becomes, therefore, important to re-examine the locality from which Professor Marsh obtained the *Cœlurus fragilis* to determine whether its deposit is really of Jurassic age, as stated by Marsh. It is, however, not fixed beyond doubt that the New Mexican locality is Triassic.—*E. D. Cope.*

Geological News. GENERAL.—M. Nouvy, in his "Geology of Jersey," assumes that the island had an original granitic crust on which the gneisses were deposited in an intensely heated ocean. The sedimentary rocks are chlorite-schist, feldspathic schist (which is most common), metamorphic schist, and conglomerate. There is much eruptive rock, varying from granitic to diorite. The author states that the age of the true granites now found cannot be proved, but that the other eruptive rocks are certainly later than the schists. No sedimentary rock exists between these Cambrian strata and the conglomerate, which he attributes to the Permian age. After a careful sifting of the evidence, he concludes that subsidence has occurred only since the Roman occupation, and that Jersey was probably still joined to Normandy in the sixth century.

DEVONIAN.—M. Ch. Deperet has studied the Devonian of the eastern chain of the Pyrenees. This formation forms a narrow band running 15° north of east, parallel to the general direction of the chain. The belt can be traced across the basins of the Aude and the Tet, from the elevated valley of the Aniège on the west to the plain of Reussillon on the east, and has a length of sixty kilometres, with a width of five kilometres at the mountain-mass of Villefranche. The western part of this Devonian crest is nearly uninterrupted, but the eastern part is cut up into fragments and thrown northwards by the granite-mass of Canigon.

MESOZOIC.—Dr. Carl Diener has published a monograph upon the geology of the Lebanon. He has worked out the numerous lines of faulting and flexuring which have occurred, mainly during the Miocene, in the strata, which, both in the Lebanon and Anti-Lebanon, are chiefly Cretaceous and Eocene Limestones. Jurassic beds occur in a narrow belt at the western base of Mount Hermon, which is to a great extent built upon the line of a great fault that coincides with its western base. The limestone beds of this mountain belong to the age of the Lower Chalk of Europe, and are disposed in the form of a low arch with a north-northeast axis. There are other faults on the south and east flanks. Doubtless the system of disturbance here is identical with that which caused the Jordan-Arabah depression; and the main line of fault of that depression enters the valley of the Leontes at the western base of Hermon. Here the Lebanon Limestone and other Lower Cretaceous beds are nearly vertical and in contact with horizontal Upper Cretaceous beds. Dr. Diener throws some doubt on the former existence of glaciers in the district because he cannot find glacial striations.

Professor Owen recently read before the Geological Society of London a paper upon *Galesaurus planiceps* Owen. The characters of the skull and teeth have been brought to light. The reptilian nature of the fossil is indicated by the single occipital condyle and other features. The angle of the jaw is not produced beyond the articular element. In general shape and bony strength the mandible of Galesaurus resembles that of a mammal. The crowns of four upper molars are triangular, the base is flanked by a short cusp before and behind, and the corresponding margins are finely crenulate. The incisors are eight in each jaw and partially interlock. The canines resemble those of a mammal. No trace of successional teeth was found. The teeth are implanted firmly in sockets. The author remarked on the earlier reptilian character exhibited by the oolitic mammal Amphitherium and by the existing Myrmecobius. The specimens are from the Triassic of South Africa.

The Triassic age of the Hawkesbury sandstone formation, New South Wales, has been proved by the discovery of a Mastodonsaurus.

Cænozoic.—Among some fossils from Wadi Halfa, Nubia, is an upper right-cheek tooth of an Equus of Pliocene type, allied to the group containing *E. sivalensis.*

M. A. Gaudry maintains the Miocene age of the Pikermi fauna, and M. Deperet has contributed to the French Academy a note upon the importance of the Pliocene beds in the south of France. It comprises twenty metres of drift, above which are one hundred metres of marine beds, while still higher there are one hundred and fifty metres of beds of continental formation. The beds of the Val d'Arno are above these, and have a very distinct fauna.

Postpliocene.—The Naulette jaw found in a cavern near Dinant (Belgium) is remarkable for its excessive prognathism. The study of it has led M. Topinard to conclude that in the age of the mammoth and tichorhine rhinoceros there were numerous mixed human races, to one of the lowest of which this jaw belonged.

M. A. Gaudry, who in July last called the attention of the French Academy to the exceptional riches of the grottoes of Mentone, in which had been collected not less than forty thousand shells belonging to one hundred and seventy-one species, has recently stated that the same grottoes contain the bones of forty-two species of birds, fourteen of them birds of prey, the others the food-birds of the primitive race who inhabited the caves. One species only is extinct, but many have disappeared from the region they then inhabited. The quail, which is now common on the Mediterranean coasts, is seen in the Mentone grottoes.

The batrachians of the Mentone grottoes are a species of toad, which no longer exists in France, and in dimensions is near the large *Bufo agua* of South America, and a frog, while seven species of fish occur, one extinct and six still living. The extinct species belongs to Strophodus, a Jurassic genus of sharks. Among the recent species are the maigre, tunny, salmon, and trout. Altogether, in the six caverns once inhabited by quaternary man, M. Gaudry reports eight hundred and forty thousand fragments, vertebrate and invertebrate, belonging to one hundred and eleven species of the former category and one hundred and seventy-one of the latter.

RECENT.—Professor J. D. Dana, in a recent article in the *American Journal of Science*, concludes, in connection with the recent disturbances at Kilauea, Vesuvius, and Tarawera, that volcanic action must be attributed to the hydrostatic pressure of the column of lava; the pressure of vapors escaping in underground regions from the lavas, or produced by contact with them, acting either quietly or catastrophically; and the pressure of the subsiding crush of the crust forcing up the lavas in the conduit.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The rocks occurring in equatorial Eastern Africa (Massai-Land) have been found by O. Mügge[2] to embrace granophyres, gneisses, mica schists, and amphibolites among the older rocks, and liparites, trachytes, nephelinites, nepheline-tephrites and basanites, limburgites, melilite-basalts, augite andesites and feldspathic basalts among the younger ones. The granophyres contain an augite with partings parallel to $\infty P \bar{\infty}$ and oP, hypersthene and hornblende, all of which are so closely and peculiarly associated that the author thinks they might be due to the solution in the granophyre substance of some foreign inclusion. The gneisses, schists, and amphibolites also contain a diallagic and an orthorhombic augite. Among the granular constituents of two specimens of amphibolite, prismatic crystals of scapolite were noticed. The porphyritic feldspathic constituent of the trachytes (acmite-trachytes) corresponds very closely to the soda-microcline of Förstner.[3]

[1] Edited by Dr. W. S. BAYLEY, Madison, Wisconsin.
[2] Neues Jahrb. fr. Min., etc., Beil. Bd., iv. p. 576.
[3] *Cf.* American Naturalist, Notes, June, 1885, p. 600.

Wollastonite and melanite, which were observed in some of the nephelinites, Mügge thinks must be looked upon as having crystallized directly from the magma of the rock itself, and not as the result of the solution of inclusions. Unfortunately, the author was not able to study these rocks in the field, so that their geological relations are not definitely known.——Bruno Doss[1] has recently made a very thorough investigation of the igneous rocks of Palestine, and as a result of his studies declares them to be labradorite basalts. Their olivine constituent occurs both in porphyritic crystals and in the ground-mass. The two generations are distinguished by the marked differences in their mode of alteration. The mineral of the first generation contains more iron than that of the second, and accordingly gives rise to decomposition products consisting principally of red iron compounds insoluble in acids, while the latter class are merely serpentinized. Twins of olivine were observed in which the twinning planes are $P\breve{\infty}$, and in less frequent instances ∞P. In three specimens pseudobrookite was detected.——The fact that quartz and olivine may occur in the same rock is given additional interest by the discovery in Northern California of a quartz-basalt. This rock is described by Mr. Diller[2] as possessing all the essential characteristics of ordinary basalts, with the addition besides of numerous grains of quartz, many of which are surrounded by a zone of glass and pyroxene. From the fact that quartz is also found in bombs, which must have existed as clots in the lava at the time of its eruption, Mr. Diller is forced to assume that the same magma which under ordinary conditions of temperature and pressure yielded olivine, under different conditions secreted quartz. This quartz-basalt is younger than the ordinary basalts of the region, just as the dacites are younger than the andesites. ——The origin of lithophysæ in the acid lavas of the Yellowstone National Park is the subject of a paper by Mr. Iddings[3] in a late number of the *American Journal of Science*. In it the author inclines to the theory first proposed by Von Richthofen, viz., that this structure is of aqueo-igneous origin, and was produced by the action of absorbed gases upon the molten glass, from which they were liberated during the crystallization consequent upon cooling. Mr. Iddings is led to this view by the facts (1) that the minerals found upon the walls of the lithophysæ (quartz, tridymite, and fayalite) are those which have been produced artificially only by aqueo-igneous methods, and (2) that the chemical composition of the substances of lithophysæ and of spherulites is essentially the same, and therefore the former cannot have been produced by the alteration of the latter.[4]——Chrustschoff[5] has isolated zircon

[1] Min. u. Petrog. Mitth., vii., 1886, p. 461.
[2] Amer. Jour. Sci., Jan. 1887, p. 45. [3] Ib., Jan. 1887, p. 36.
[4] *Cf.* American Naturalist, Notes, Jan. 1887, p. 70.
[5] Min. u. Petrog. Mitth., vii., 1886, p. 423.

from gneisses, granites, trachyte, basalt, sanidine bombs, and graywackes, and has described the characteristic peculiarities of crystals obtained from these different sources. He has found that the crystals occurring in gneisses always present rounded contours, while those in granite are always defined by sharp crystal planes. He proposes to make use of this fact in distinguishing gneisses with granitic habit from true granites.

Mineralogical News.—*Kaliophilite* is the name proposed by Mierish[1] for a new mineral occurring in colorless needles in one of the Monte Somma bombs examined by him in the course of his work referred to in the March number of this journal. It is a potassium nepheline. An analysis yielded,—

SiO_2	Al_2O_3	CaO	K_2O	Na_2O
37.48	32.43	2.18	27.20	2.26

The author supposes that ordinary nepheline may consist of mixtures of the isomorphous molecules $K_2Al_2Si_2O_8$ and $Na_2Al_2Si_2O_8$, since this mineral always contains more or less potassium. The group of nephelines is now known to consist of at least three members, the third being the mineral eucryptite, discovered by Brush and Dana[2] among the alteration products of spodumene. ——*Scapolite.*—In no manner can the difference in the views of the two schools of mineralogical chemists be better learned than by an examination of the papers relating to the discussion now being carried on in Germany and Austria in regard to the nature of the scapolite group of minerals. In an article in the *Neues Jahrbuch*, Rammelsberg[3] gives his reason for considering this group of minerals as consisting of molecular combinations of normal- (meta-), half- (ortho-), and di- (bi-) silicates of sodium, calcium, and aluminium in certain definite proportions. *Sarkolite*, for instance, he regards as a molecular compound made up of the three ortho-molecules in the proportions $3Na_4SiO_4$, $27Ca_2SiO_4$, $10Al_4(SiO_4)_3$; and *Meionite*, from Mt. Vesuvius, as a similar compound, in which the meta-silicates are present in the proportions of one molecule to six of the ortho-silicates, as,—

$$6\left\{\begin{array}{l}Na_4SiO_4\\ 6\left\{\begin{array}{l}4Ca_2SiO_4\\ 3Al_4(SiO_4)_3\end{array}\right.\end{array}\right\} + \left\{\begin{array}{l}Na_2SiO_3\\ 6\left\{\begin{array}{l}4CaSiO_3\\ 3Al_2(SiO_3)_3\end{array}\right.\end{array}\right\} + 20NaCl.$$

Tschermak,[4] on the other hand, regards the members of this group (like those of the plagioclase group) as isomorphous mixtures of the two molecules $4CaO,3Al_2O_3,6SiO_2 = Ca_4Al_6Si_6O_{25}$ and $Na_8Al_6Si_{18}O_{48}Cl_2 = 3Na_2O,3Al_2O_3,18SiO_2 + 2NaCl$, which he calls respectively the meionite and mariolite molecules. By

[1] Tschermak's Min. u. Petrog., Mitth. viii., 1886, p. 156.
[2] Amer. Jour. Sci., III. xx., 1880, p. 257.
[3] Neues Jahrbuch f. Min., etc., Beil. Band, iv., 1886, p. 610; also Sitzb. Berl. Akad., Bd. 30, p. 589.
[4] Min. u. Petrog. Mitth., vii., 1886, p. 400.

the combination of these two molecules in different proportions the various members of the group are formed, and by calculation the proportionate amounts of each present in any given case can readily be determined from the amounts of calcium and sodium found by analysis.——*Bastonite*, a micaceous mineral characterizing certain sandstones and arkoses, is supposed by Renard to be very similar to vermiculite, which Tschermak regards as an altered phlogopite. Its analysis yielded Klement,[1]—

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O
36.91	20.04	20.01	3.73	trace	0.95	7.96	3.07	0.22	6.98

——According to the investigations of Nordenskiöld,[2] the peculiar fluid inclusions in Brazilian topaz, to which Dana gave the name "brewsterlinite," are, at least in some cases, inclusions of a hydrocarbon, probably of the naphtha group.——Schuster[3] has discovered that the *braunite* from the manganese mines of Jakobsberg, in Wermland, Sweden, is probably isomorphous in crystallization with hematite and ilmenite. Its analysis yielded Igelström,[4]—

SiO_2	MnO	FeO	MgO.CaO	PbO	O
8.7	80.23	1.33	0.95	8.65	8.17

If the iron, magnesium, calcium, and lead be supposed to replace manganese, the composition of the mineral may be represented by the formula $11Mn_2O_3.3MnSiO_3$, corresponding very nearly to the result reached by Rammelsberg in his analysis of the braunite from Elgersburg.

Crystallographic News.—Recent measurements of crystals of *vanadinite* from Pinal County, Arizona, have yielded Mr. Penfield[5] results agreeing closely with those obtained by Urba[6] in his investigations of Carinthian crystals. *Endlichite*[7] $[Pb_5Cl(AsO_4)_3 + Pb_5Cl(VO_4)_3]$ from the Sierra Grand Mine, Grant County, New Mexico, was also examined. The axial ratio, as determined by Penfield, is $a:c = 1:.7495$. The presence of arsenic in the mineral seems to tend to increase very perceptibly the length of the vertical axis as compared with that of the pure vanadium mineral (in vanadinite $a:c = 1:.7112$).——The new forms 2O, 1106, and 6O4 have been observed by E. S. Dana[8] on crystals of native *copper*. In the same paper the author describes crystals which, by development in certain directions, assume the rhombohedral symmetry. The twinning laws of copper are also investigated, and the article concludes with plates containing fifty-

[1] Min. u. Petrog. Mitth., viii., 1886, p. 1.
[2] Neues Jahrb. f. Min., etc., 1886, i. p. 242.
[3] Min. u. Petrog. Mitth., vii., 1886, p. 443.
[4] Annales des Mines de Wermland, 1884, p. 73.
[5] Amer. Jour. Sci., December, 1886, p. 441.
[6] Zeitschrift f. Kryst., iv. p. 353.
[7] American Naturalist, Notes, July, 1885, p. 709.
[8] Amer. Jour. Sci., December, 1886, p. 413.

four illustrations of copper crystals and crystal groupings.—— From new measurements of crystals of *hyalosiderite*, the iron-rich olivine, and *forsterite*, the pure magnesian variety, Max Bauer[1] has recalculated the axial relations of these minerals. For the first he finds $\check{a}:\bar{b}:\acute{c} = .46815:1:.58996$; for the second, $\check{a}:\bar{b}:\acute{c} = .46476:1:.58569$. On comparing these ratios with those obtained from measurements made on *fayalite*, the pure iron olivine, and other members of this series, the composition of which is known, it is found that an increase in the amount of the magnesium molecule present in any case is accompanied by a shortening of the $\check{a}$ and $\acute{c}$ axes as compared with the $\bar{b}$ axis.——In the same article Bauer describes twinning lamellæ in massive *barite* from several localities in Germany. The twinning plane is $6P\bar{\infty}$. He regards them as pressure twins like those found in calcite, cyanite, sphene, etc.

Miscellaneous.—In the January number of the *American Journal of Science*[2] Mr. G. F. Becker has an interesting article on "The Texture of Massive Rocks." The subject is treated theoretically, and in such a manner that a brief synopsis of it would be most unsatisfactory. Suffice it to state here that Mr. Becker supposes the formation of plutonic granitoid rocks to represent an extreme and highly exceptional case of neutral chemical equilibrium in a pasty magma, by the cooling of which they were derived. As a rule, however, he regards granular structure as characteristic of metamorphosed sediments.[3] Porphyrite structure is the natural result of slow cooling of a very fluid magma, and is merely the evidence of fractional crystallization of the various minerals. These conclusions are based on a theory of the solidification of minerals in accordance with certain laws of thermo-chemistry.[4]——In a letter to the *Neues Jahrbuch für Mineralogie*,[5] A. Schrauf explains his views on morphotropism and atometrie, which, so far as they relate to minerals, are briefly as follows. The form of crystallization of chemical mixtures depends principally upon the various amounts of their constituents. $MgSO_4 + 7H_2O$ (epsomite) crystallizes in the orthorhombic system, while $FeSO_4 + 7H_2O$ (melanterite) is monoclinic. Mixtures of $MgSO_4 + 7H_2O$ and $FeSO_4 + 7H_2O$ crystallize in the latter system until the proportion of magnesium in the mixture is to the amount of iron as three atoms to one atom $(3MgSo_4 + FeSo_4) + 7H_2O$, when it crystallizes in the orthorhombic system,—*i.e.*, the crystallization is determined by that substance which is in excess (by weight). In the compound $(3MgSo_4 + FeSo_4) + 7H_2O$ the Mg and

[1] Neues Jahrb. f. Min., 1887, i. p. 1.
[2] Amer. Jour. Sci., January, 1887, p. 50.
[3] *Cf.* American Naturalist, Notes, December, 1886, p. 1050.
[4] Amer. Jour. Sci., 1886, p. 120.
[5] Neues Jahrb. f. Min., 1886, i. p. 234.

Fe are to each other as 72 : 56, Mg is in excess, and the substance crystallizes as does $MgSo_4 + 7H_2O$. In compounds containing less Mg (as $2MgSo_4 + FeSo_4) + 7H_2O$, the proportions of Mg and Fe are as 48 : 56, and the crystallization is that of melanterite. Various conditions effect the crystallization of mixed bodies, but the most important of these, according to Schrauf's opinion, is the one mentioned above. If this law is found to be general in its application, the present views in regard to the dimorphism of many compounds belonging to the so-called iso-dimorphous groups will have to be modified.

BOTANY.[1]

Botanical Manuals for Students.—Nowadays we are urging students to collect and study plants from all the great groups, and thereby to familiarize themselves with the vegetable kingdom as a whole, but perhaps we too often overlook the difficulties which lie before them. Not the least of these is the want of systematic manuals in which descriptions of the genera and species may be found. It is all very well to tell a student that the name and technical description are of much less importance than is the knowledge of structure and habits. It is true, no doubt, but, for all that, there is need of such works in every laboratory, to serve *as guides*, if for no other purpose. Unfortunately for the American student, we are as yet poorly supplied with descriptive manuals. In the following list I have enumerated the classes (and in some cases the orders under the classes) of the several great branches of the plant kingdom, giving for each the name of a useful systematic manual. I have not attempted to make a list of the works of this kind which are *absolutely the best*, for too often such works are too expensive for the limited means of the botanical departments of many schools and colleges.

PROTOPHYTA.

MYXOMYCETES.—Cooke's Myxomycetes of Great Britain.

SCHIZOMYCETES.—Grove's Bacteria and Yeast Fungi.

CYANOPHYCEÆ.—[2] Cooke's British Fresh-Water Algæ, pp. 203–282, and, doubtfully, pp. 1–30.

ZYGOPHYTA.

ZOOSPOREÆ.—Cooke's British Fresh-Water Algæ, pp. 67 (Pandorina), 35–49 (Hydrodictyon, etc.), 135–145 (Confervaceæ); and Farlow's New England Algæ, pp. 41–44 (Ulvaceæ), and 61–98 (Phæosporeæ).

[1] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

[2] During the year the work on the "Fresh-Water Algæ of North America," by Francis Wolle, may be expected. When that appears it should be substituted for the "British Fresh-Water Algæ" wherever the latter occurs in this list.

CONJUGATÆ.—*Desmidiaceæ.* Wolle's Desmids of the United States.

Diatomaceæ. Van Heurck's Synopsis des Diatomées de Belgique.

Zygnemaceæ. Cooke's British Fresh-Water Algæ, pp. 74–110.

Mucorini.[1] Winter's Rabenhorst's Kryptogamen Flora.

OÖPHYTA.

ZOOSPOREÆ.—Cooke's British Fresh-Water Algæ, pp. 56–67 (Volvox, etc.), 132–134 (Sphæroplea).

ŒDOGONIEÆ.—Cooke's British Fresh-Water Algæ, pp. 148–177.

CŒLOBLASTEÆ.—*Vaucheriaceæ.* Cooke's British Fresh-Water Algæ, pp. 115–126.

Saprolegniaceæ.[1] Winter's Rabenhorst's Kryptogamen Flora.

Entomophthoreæ. Winter's Rabenhorst's Kryptogamen Flora, pp. 74–79.

Peronosporeæ. Farlow's Peronosporeæ of the United States.

FUCACEÆ.—Farlow's New England Algæ, pp. 99–104.

CARPOPHYTA.

COLEOCHÆTEÆ.—Cooke's British Fresh-Water Algæ, pp. 195–197.

FLORIDEÆ.—Farlow's New England Algæ, pp. 106–183.

ASCOMYCETES.—*Perisporiaceæ.* Bessey's Erysiphei.

Tuberaceæ. Cooke's Hand-Book of British Fungi, pp. 738–750.

Helvellaceæ. Cooke's Hand-Book of British Fungi, pp. 655–737.

Pyrenomycetes. Winter's Rabenhorst's Kryptogamen Flora, vol. ii.[2]

Lichenes. Tuckerman's North American Lichens.

Uredineæ. Burrill's Parasitic Fungi of Illinois.

Ustilagineæ. Winter's Rabenhorst's Kryptogamen Flora, pp. 79–131.

BASIDIOMYCETES.—Winter's Rabenhorst's Kryptogamen Flora, pp. 270–922, and Cooke's Hand-Book of British Fungi, pp. 1–376, and 409–413.

CHARACEÆ.—Halsted's American Species of Characeæ.

[1] The orders Mucorini and Saprolegniaceæ have not yet been reached in the publication of the "Kryptogamen Flora," but no doubt they will be soon.

[2] Not yet quite completed.

BRYOPHYTA.

Hepaticæ.—Underwood's North American Hepaticæ.

Musci.—Lesquereux and James's Mosses of North America.

PTERIDOPHYTA.

Underwood's Ferns and their Allies.

PHANEROGAMIA.

There is no complete Phanerogamic Flora of the United States. The Gamopetalæ have been completed in Gray's "Synoptical Flora of North America." For the remaining flowering plants we must make use of the various local Floras, as follows:

For the Northeastern United States (*i.e.*, north of North Carolina and Tennessee, and west to the Missouri River), Gray's "Manual of Botany." For the Southeastern United States (*i.e.*, south of the preceding, and west to the Mississippi River), Chapman's "Flora of the Southern United States." Wood's "Class-Book" is intended to include all the Phanerogams of both the foregoing regions. For the region west of the Sierra Nevada Mountains, Watson's "Botany of California," or Rattan's "Popular California Flora." For the Rocky Mountains and the Plains, Coulter's "Manual of Rocky Mountain Botany." Strictly speaking, Coulter's Manual is intended to cover Colorado, Wyoming, Montana, Western Dakota, Western Nebraska, and Western Kansas, but its usefulness extends a couple of hundred miles farther in every direction. The Great Basin of Utah and Nevada and the Arizona-Texas region have no manuals as yet. For these regions Watson's "Catalogue of the Known Plants of Nevada and Utah" (*U. S. Geol. Explor. of the 40th Parallel*, vol. v.) and Rothrock's "Catalogue of the Plants collected in Nevada, Utah, Colorado, New Mexico, and Arizona" (*U. S. Geog. Surveys West of the 100th Meridian*, vol. vi.) will render good service.

Full titles of most of the foregoing works are given below, with approximate prices:

The Myxomycetes of Great Britain. M. C. Cooke. London, Williams & Norgate. $2.50.

A Synopsis of the Bacteria and Yeast Fungi. W. B. Grove. London, Chatto & Windus. $1.25.

British Fresh-Water Algæ. M. C. Cooke. London, Williams & Norgate. $22.00.

Marine Algæ of New England. W. G. Farlow (Rept. U. S. Fish Commission, 1879). Washington. $2.50.

Desmids of the United States. Francis Wolle. Bethlehem, Pa. $5.00.

Synopsis des Diatomées de Belgique. Henri van Heurck. Anvers. $50.00.

Rabenhorst's Kryptogamen Flora: Die Pilze. George Winter. Leipzig. Ed. Kummer. $16.00.

Enumeration of the Peronosporeæ of the United States. W. G. Farlow. *Botanical Gazette*, Oct. and Nov., 1883.

On Injurious Fungi: The Blights (Erysiphei). C. E. Bessey. Seventh Biennial Rept. Iowa Agricultural College, 1877.

Hand-Book of British Fungi. M. C. Cooke. London, Macmillan & Co. $12.00.

A Synopsis of the North American Lichens. Ed. Tuckerman. Boston, S. E. Cassino. $3.00.

Parasitic Fungi of Illinois: Uredineæ. T. J. Burrill. Bulletin Ill. State Laboratory of Nat. History, vol. ii., 1885.

Classification and Description of the American Species of Characeæ. B. D. Halsted. Proc. Boston Soc. Nat. History, vol. xx., 1879.

Descriptive Catalogue of the North American Hepaticæ North of Mexico. L. M. Underwood. Bulletin Ill. State Laboratory of Nat. History, vol. ii.

Manual of the Mosses of North America. L. Lesquereux and T. P. James. Boston, Cassino & Co. $4.00.

Our Native Ferns and their Allies. L. M. Underwood. Bloomington, Ill. $1.25.

Synoptical Flora of North America. Asa Gray. New York, Ivison, Blakeman, Taylor & Co. $6.00.

Manual of the Botany of the Northern United States. Asa Gray. Same publishers. $2.00.

Flora of the Southern United States. A. W. Chapman. Same publishers. $4.00.

Manual of the Botany of the Rocky Mountain Region. J. M. Coulter. Same publishers. $1.85.

Class-Book of Botany. A. Wood. New York, Barnes & Co. $3 50.

Botany of California. S. Watson. Cambridge, Mass., Welch, Bigelow & Co. $10.00.

A Popular California Flora. V. Rattan. San Francisco, Bancroft & Co. $1.00.

The two government reports (Watson's and Rothrock's) cannot probably be obtained from the government offices any longer. They may be bought of second-hand dealers for from $3.00 to $5.00 each.—*Charles E. Bessey.*

The Eighteenth and Nineteenth Centuries of North American Fungi.—About the middle of March these two centuries were received by subscribers from the hands of the authors, Messrs. Ellis and Everhart. Century XVIII. is notable for the great number of difficult micro-fungi which it contains. Thus, of the genus Cercospora there are specimens of thirty-four species; of Septoria, twelve; of Phyllosticta, seven; and of Sphærella, four. The larger fungi are represented by fine specimens of half a dozen Polypori. Trametes, Hydnum, Radulum, Grandinia, Merulius, Hymenochæte, Stereum, Corticium, Næmalelia, and Exobasidium are represented by one or more species each,—that of the genus last named being the striking *E. discoideum* of Ellis, found on "the under-side of living leaves of *Azalea viscosa*."

Century XIX. is mainly devoted to the Uredineæ, there being no less than twenty-three species of Æcidium, twenty-eight of Puccinia, and sixteen of Uromyces, besides eight more of various genera, making a total of seventy-five. The remaining species are divided among eight or nine genera, of which Ustilago includes six, Peronospora three, Cystopus two, and Entomophthora two. It is scarcely necessary to say that the specimens are highly satisfactory.—*Charles E. Bessey.*

Tomato-Rot.—Dr. J. C. Arthur has been studying tomato-rot, and ascribes that observed in 1886 to fermentation. In the "Fifth Annual Report of the New York Agricultural Experiment Station," he says, "The fermentive action is evidently not begun until the resistance of the living tissues is greatly reduced or entirely lost. This may be brought about in several ways. All fruit reaches this condition of inability to resist the inroads of disease-germs, or of germs of disintegration, when it becomes fully ripe,—literally dead-ripe. The condition may be prematurely brought on by anything which decreases the vigor of the plant, and thus enfeebles and shortens the life of its ripening tissues. A marked, and from several points of view an interesting, example of the early and extensive rotting of ripe fruit in plants constitutionally debilitated by propagation for three seasons from seed successively selected from the feeblest plants of the preceding year is recorded by Mr. Goff, in which finally half the ripe fruit prematurely rotted. This kind of decay is very appropriately called 'soft rot,' and is well described by Mr. Goff as follows: 'The fruit becomes soft, and collapses without changing color; the skin finally bursts, permitting the contents to flow out, when it dries without detaching itself from the stem.' If the fruit rests upon the ground it often cracks open, and the exposed surface becomes speedily covered with a white, velvety growth, composed of yeast and *Oidium lactis*, which for a considerable time prevents the contents from escaping. This white growth, with the associated bacteria, is only a more obvious development of the active agents of fermentation which destroys the fruit."

Dr. Arthur insists upon the necessity of discriminating between the "soft rot" of ripe fruit and the other kinds which chiefly affect green fruit, and suggests that one means of avoiding the former "is to maintain the health and increase the vigor of the plants by judicious breeding."

Botanical News.—Fascicle V. of Millspaugh's "American Medicinal Plants" was delivered to subscribers a month or two ago. Like the preceding fascicles, this one contains thirty plates, all of which are well done.——Professor Penhallow's "Mechanism of Movement in Cucurbita, Vitis, and Robinia" ("Proc. and Trans. Royal Soc. of Canada," vol. iv., 1886) treats of the tendril-movements of the first and second, and leaf-movements of the last. Three plates accompany the paper.——The "Additional Notes upon the Tendrils of Cucurbitaceæ" (*Can. Record of Science*, October, 1886), by the same author, continues the work in the order mentioned. Twenty-two species belonging to nine genera were under observation. The principal inquiry in this paper was that relating to the strength of tendrils, or of the spirals which they form.——B. D. Jackson gives an account, in the March *Journal of Botany*, of the new "Index of Plant Names," now under way. It is the intention to make a complete index of all genera and species of Phanerogams, so as to give "a view of the actual state of botany at the end of 1885."——The principal article in the March *Botanical Gazette* is one by Dr. Gray on Delphinium. It is an "essay at a rearrangement of our species," and is submitted in the hope of eliciting from botanists such observations and criticisms as will either confirm or invalidate the characters used.

ENTOMOLOGY.[1]

The Joint-Worm in New York.—Twenty-five years ago *Isosoma hordei* did a great amount of injury to wheat, barley, and rye in this State; in some localities the yield was reduced fully fifty per cent. But during recent years this insect has attracted almost no attention. The present generation of farmers do not even know the characteristic signs of its ravages. There are, however, indications that the causes that have kept it in check, whatever they may be, are ceasing to be effective. And it is more than probable that unless care is exercised by the grain-growers of the State, there will be a repetition in the near future of the great losses of a quarter-century ago. The insect has already become very abundant in the northern part of Tompkins County. But I am not aware that the farmers even suspected its presence until their attention was called to it at a recent farmers' institute. The proprietors of a paper-mill at Ithaca have found that the straw received from certain localities is unfit for making paper, owing to the solidification of considerable portions of it by the injuries of this insect. In one lot of straw received from

[1] This department is edited by Prof. J. H. COMSTOCK, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

a packer at Lake Ridge one-twenty-fifth of the straws were infested, and the straw received from another locality was very badly injured. The matter is certainly worthy serious attention. Articles published by Cook and by Riley in the *Rural New-Yorker* some time since indicate that this pest is also increasing unduly in Michigan and in Ohio.—*J. H. Comstock.*

Relations of Ants and Aphids.—The great benefits derived by ants from plant-lice have been long known. Many species of ants obtain a considerable proportion of their subsistence from Aphids and allied insects, honey-dew constituting the chief part of their food. But in what way the plant-lice profit by this association is probably only partially understood. The slight amount of protection afforded by the ants in occasionally driving insectivorous insects away from colonies of Aphids can hardly be sufficient to account for the development of the apparatus for excreting honey-dew. The fact, now well known, that certain ants collect and preserve in their nests the eggs of Aphids during the winter, indicates that there are more important relations between the two groups of insects than appear at first sight. And this is confirmed by the recent discovery by Professor Forbes that the corn plant-louse (*Aphis maidis*) is strictly dependent on an ant (*Lasius alienus*). This ant in the early spring mines along the principal roots of the corn, collects the wingless lice that have hibernated in the earth and conveys them into its burrows, and there watches and protects them. Experiments indicate that the plant-lice are unable to establish themselves upon the roots of corn without the aid of ants, even when placed in great numbers at the base of the hill of corn.—*J. H. C.*

Dipterous Larvæ in Sarracenia purpurea.—Dr. Riley has recorded (*Canadian Entomologist*, vol. vi. p. 209) some interesting observations concerning a flesh fly (*Sarcophaga sarraceniæ* Riley), which lives in its larval state in the liquid contained within the leaves of the Southern pitcher-plants, *Sarracenia variolaris* and *S. flava*, subsisting upon the dead bodies of the insects caught by the plants. It may be of interest to record that the same or a similar species inhabits the watery liquor contained within the leaves of the common Northern pitcher-plant, *S. purpurea.* While taking a vacation in the pine-wood regions of Northern Michigan (Missaukie County) last August, I found this interesting plant very abundant in the swamps and marshes. About ten per cent. of the leaves contained larvæ that agree with the figure and description of the larva of *S. sarraceniæ*, but unfortunately I was unable to rear the fly. Many of the leaves contained circular holes, out of which some of the larvæ had doubtless emerged to pupate. When the water contained within the leaves was emptied into a glass vessel, these Sarcaphagous larvæ could be easily seen swimming about in search of food and attaching themselves to any plump carcass that came in their way. When placed in ordinary commercial alcohol they would live between three and four hours.

As is well known, the prevailing color of the leaves of this plant is a livid red, and it is worthy of note that the commonest of the larger insects found within them belonged to that family which is said to be especially attracted by this color,—the Vespidæ or wasps. It is probable, also, that this color may have some attractive influence over various two-winged flies,—including the parents of the larvæ mentioned above.—*Clarence M. Weed, Champaign, Ill.*

Bacteriological Studies in Arthropods.—M. E. G. Balbiani[1] finds that saprophytic bacilli, when inoculated into the blood, are pathogenic for a large number of Arthropods. Death follows in from twelve to forty-eight hours, according to external temperature, number and origin of spores, size, age, and susceptibility of the subject. They die with all of the symptoms which characterize the disease known as "flacherie" in silk-worms, a malady determined by the development of various species of bacteria in the organism. Insects of the different orders are not equally susceptible; those which contain a small quantity of blood in proportion to the mass of the body (Lepidoptera, Diptera, Hymenoptera) are killed more rapidly and surely than those in which the relative proportion of blood is greater, and (above all) in which the blood is richer in corpuscles; this is specially the case with the Gryllidæ.

The resistance is due to the corpuscles seizing by their pseudopodia on the bacilli, and to the elements of the pericardial tissue, which seize on and destroy the poisonous organisms. This identity in mode of action is ascribed to the genetic relation which exists between the two kinds of cells. Death is delayed if the spores are kept for more than six years in a state of desiccation.—*Jour. Roy. Micr. Soc.*, 1887, p. 70.

Ants and Ultra-Violet Rays.—Whilst Sir J. Lubbock considers that ants perceive the ultra-violet rays by means of their eyes, Graber finds, by removing these organs from Tritons, etc., that it is by the skin that these rays are perceived. Prof. A. Forel has made experiments in order to answer the question whether ants perceive these rays by means of their eyes, or by the skin; and he finds that it is mainly by the former organs, but admits that "photodermatic" perception may accompany the optic sense. *Camponotus ligniperdus* and *Formica fusca* served for his experiments, and a "solution d'esculine" was used for absorbing the ultra-violet rays.—*L. c.*, p. 73.

[1] Comptes Rendus, ciii. (1886) p. 952–54.

Light-Perception by Myriapods.—Fourteen years ago Pouchet showed that muscid larvæ without eyes were still sensitive to light, and Graber (as indicated above) has recently in some striking experiments extended the same conclusion. Prof. F. Plateau[1] gives a careful historical survey of what is known in regard to light-sensitiveness among invertebrates, and reports the result of his own researches on blind Myriapods.

His method of experiment was manifold. That of Pouchet, that of Graber, and two other modifications were employed in order to determine whether the blind Myriapods were able to perceive light, while in another series M. Plateau sought to determine the rapidity of perception.

His chief results are summed up as follows: The blind chilopod Myriapods perceive the daylight, and are able to choose between it and darkness; in the chilopod Myriapods provided with eyes, and in those without these organs, a considerable time must elapse before the animals perceive that they have passed from relative or complete obscurity to daylight; the length of this period is not greater in the blind Myriapods than in those with eyes; owing to the general slowness of perception, blind Myriapods, although sensitive to light, may cross a dark space of small extent without perceiving it, or being able to find it again when they have left it; the rapid search for a hole in the soil is explicable, not only as a flight from light, but as an expression of the necessity for a damp environment, with which the greater part of the body may be in direct contact.—*L. c.*, p. 76.

The Hessian Fly in England.—At a meeting of the Entomological Society of London, held December 1, Miss Elenor A. Ormerod read a paper and exhibited specimens of the Hessian Fly (*Cecidomyia destructor*) taken in Hertfordshire, England. The specimens undoubtedly belonged to this species, as they had been compared with authentic American and Austrian examples.

Function of the Palpi in Chilopods and Spiders.—Felix Plateau has recently investigated the question of the function of these organs, and has published the account of his experiments in the *Bulletin* of the Zoological Society of France (1886, p. 512). He reviews the previous opinions on the subject, and experimentally demonstrates that in Lithobius, etc., they are used neither as organs of sense nor in the capture of food. He assigns them the function of cleaning the antennæ. The so-called palpi in the male spiders, as is well known, serve to convey the spermatozoa to the female reproductive organs. Of the functions of these organs in the females almost nothing is known. Some have regarded them as sensory, and have described organs of smell upon

[1] Jour. de l'Anat. et de la. Physiol., xxii. (1886) pp. 431–57.

them. Some consider them as of use in the capture of food, and others think they play a part in the building of a web. Plateau's experiments were upon five species belonging to as many genera. The results were that these species, when deprived of their palpi, spun normal webs and captured their prey as well as their unmutilated fellows. He concludes that these appendages are to be placed, like those of the mandibulate insects, in the category of useless organs. His experiments on scorpions and Phalangium gave negative results, as these forms refused to feed. Plateau thinks that the primitive form from which both fossil and recent Arthropods have sprung varied but little from an embryonic type. The segments of its body were all similar in shape and size, and each bore a pair of many-jointed appendages. In development some of the anterior segments became modified, the basal joints of the appendages became concerned in manducation, while their distal joints, now relieved of ambulatory functions, are in various stages of atrophy and have lost their original meaning. In some cases (Arachnida) they have taken a new function.

Necrology.—M. Maurice J. A. Girard died the 8th of September last, in his sixty-fourth year, at Lion-sur-Mer (Calvados). Dr. Girard was the author of several important entomological works. The chief of these is his "Traité Elémentaire d'Entomologie." This was completed only in 1885, and comprises three large volumes and an atlas of many plates.

M. Jules Lichtenstein died on the 30th of November last, at Montpellier, France, at the age of sixty-eight. M. Lichtenstein was a vineyard proprietor, and made a special study of the habits of the Grape Phylloxera, and of allied Aphids. He was one of the most prominent and original of the French writers on these subjects.

Edgar, Freiherr von Harold, died August 1, 1886, at Possenhofen, Bavaria. He is best known to American entomologists as one of the authors of the "Catalogus Coleopterorum" and editor of the "Coleopterologische Hefte."

Entomological News.—The "First Supplement to the List of Coleoptera of America, North of Mexico," by Samuel Henshaw, is published in the *Entomologica Americana*, vol. ii., No. 11. The names of two hundred and thirteen additional species are given, and many changes indicated.——The *Canadian Entomologist* for December contains the conclusion of an important article by Grote on the Geographical Distribution of North American Lepidoptera. Several very interesting tables are given.——At a meeting of the Entomological Society of London on December 1, Mr. Poulton exhibited the bright green blood of the pupa of *Smerinthus tiliæ*, which is one of many Lepidopterous pupæ possessing a chlorophyll-like pigment (called metachlorophyll by Mr. Poulton) in the blood. By means of a micro-spectroscope the most characteristic absorption-band of the pigment, together with its resemblance to chlorophyll, was shown.——The well-known American entomologist, Mr. A. R. Grote, has been presented by His Highness the Duke of Saxe Coburg-Gotha (brother-in-law of Her Majesty the Queen) with the large Silver Medal, *Princeps Musarum Sacredos*, for Art and Science.——The January number of the *Wiener Ent. Zeit.* contains the second and concluding part of the Supplement to the Monograph of the Œstridæ by Dr. Brauer. In this part the characters of the fully-developed larvæ are discussed, and an analytical table of the genera given. There is also an analytical table for determining the genera of the adult insects.

ZOOLOGY.

Fauna of Novaia Zemlia.—Anton Stuxberg contributes to the fifth volume of the scientific results of the "Vega" expedition a review of the fauna of Novaia Zemlia. Of the sixteen mammals he enumerates two lemmings, one wolf, two foxes, the polar bear, and the reindeer as terrestrial; all the others are marine. The birds number forty-one. The fishes are not enumerated, but one is struck with the relative proportions of the different orders of Hexapods. Of these the Diptera number eighty-two, the Hymenoptera forty-six, and the Collembola sixteen out of a total of one hundred and fifty-four. The only Myriapod is a species of Lithobius. The Arachnids number forty-eight. Of the Crustacea only the Malacostraca are included. Of these there are ninety-six, sixty-one of this number being Amphipods. The Chætopods are one hundred and twenty-three in number, the true Molluscs one hundred and twenty, the Echinoderms thirty-seven. The total is seven hundred and forty-two species.

Pelagic Fauna of German Lakes.—Dr. Otto Zacharias read a paper at the late meeting of German naturalists and physicians in Berlin on the pelagic fauna of the North German lakes. The results of the exploration of fifty-six bodies of water were that there was a great similarity between their pelagic fauna and that of the Swiss and Northern Italian lakes. Some novelties were obtained: a new species of Ceriodaphnia, two of Bosmina, etc. The catalogue of his collections shows that there is a considerable similarity between these North German lakes and those of our Northern States, so far as pelagic invertebrates are concerned.

The Structure of Fungia.—Mr. Gilbert C. Bourne, who has been enabled by a grant of funds to visit the East Indies, gives in the January number of the *Quarterly Journal of Microscopical Science* (xxvii. p. 293) an account of the structure of a species of mushroom coral occurring at the island of Diego Garcia. He did not succeed in finding the budding phase which has been described by Moseley, nor did he find any ova or spermatozoa. He gives somewhat detailed accounts of the soft parts, and shows that in these forms the tentacles are arranged in circles, there being seven circles in his species which correspond to the seven orders of septa. In describing the internal structure Mr. Bourne has coined the term mesoglœa for the third layer which separates the ectoderm and entoderm in all Cœlenterates. This layer is frequently called mesoderm, but it is far from proven that it is homologous with the layer called by that name in the higher Metazoa. The new term signifies middle jelly, and hence corresponds to the terms Gallertsubstanz and Gallertanlage of the Germans. The mesenteries are described, together with the mesenterial filaments, which, by the way, our author has not seen protruded from the cinclides in the species studied by him. In the endoderm he found peculiar masses of rounded nucleated cells, which, from their turning blue when treated with iodine, he regards as symbiotic algæ. His observations on the relation of the animal to the skeleton are regarded as confirmative of Von Koch's views of the formation of the latter.

The Life-History of the Hydromedusæ.—Under this title Dr. W. K. Brooks presents an extensive paper in the third volume of the *Memoirs of the Boston Society of Natural History*, illustrating his points by eight plates. He describes the life-histories of Cunocantha, Liriope, Turritopsis, and Eutima, four genera which are taken as representatives of as many groups of Hydromedusæ. From these the author arrives at the same conclusions as Böhm and Claus: that the medusa form is primitive, the hydra condition being a secondary development in the phylogeny of the Hydrozoa; a view diametrically opposite from that usually held. The various types of alternation of generations exhibited by these forms are placed in their proper sequence, and it is pointed out that, on the supposition that the primitive hydrozoan had a hydra-like condition, the modifications exhibited are utterly inexplicable, while, if the reverse be assumed, these alternations are readily seen to be the results of a free swimming ancestral stage. The existence of a true gastrulation in the Cœlenterates is questioned. A critical review of the literature of the development of the Hydromedusæ is given.

Turning Hydra inside out.—Trembley's oft-described experiment of turning the fresh-water Hydra inside out has but rarely been repeated, Professor Mitsikuri, of Tokio, being the only person who had been successful until a recent date. According to the accounts, the Hydra in this condition lived as well as before, its digestive layer functioning well as skin, while the skin took upon itself the capacity of assimilation. Recently M. Nussbaum took up the problem, and, according to his account as presented in the *Biologisches Centralblatt*, the layers do not thus change place. There appears, indeed, an ectoderm, but this arises, not from an alteration of the endoderm, which has taken an external position by the operation of turning inside out, but by a growth of ectoderm from that of the basal pore and from the tentacles. He further maintains that ectoderm is always ectoderm, and endoderm can never be modified into any other layer. In regard to the reproduction of lost parts described by both Baker and Trembley, as well as many later observers, Nussbaum says that both layers must be present in order to have the missing portions reproduced.

Renal Organs of Invertebrates.—Dr. McMunn has recently been investigating the subject of so-called renal organs in various molluscs as well as in the cockroach. The method was to boil the suspected organ in distilled water to dissolve the uric acid or urates. The solution was then evaporated, extracted with absolute alcohol, and then the residue was boiled again in water, filtered, and to the filtrate acetic acid was added in excess, and, after some hours' standing, crystals of uric acid and urates were distinguished under a one-fifth objective. Other chemical tests were applied and with the same results. The conclusion was that the so-called urinary or Malpighian tubules of insects and the nephridia of Limax and Helix are in reality urinary in function, as has been heretofore believed.

Migration of Frogs.—A peculiar migration of frogs takes place in the valley of the Red River of the North. The water of this river is green, like that of the Great Lakes, and the bottom is composed of soft clay several feet thick, which the frost never penetrates. To the west of the river, in Dakota, are numerous prairie sloughs, which freeze in winter. The frogs hibernate in the river bottom during winter, but every spring the entire army migrates to the sloughs, returning *en masse* in the fall. I used to regard the exaggerated newspaper accounts of these migrations as fictions; but last autumn, in Fargo, I saw the frogs hopping towards the river in large numbers and the citizens gather them for a two-weeks' feast. The river is very low and the banks very dry in summer, and the frogs are obliged to migrate or die of starvation, as their favorite fly loves water-plants.—*W. H. Ballou.*

Brazilian Reptilia.—Professor E. D. Cope recently read a paper on a collection made by Mr. H. H. Smith near Cuyabá, in the southern interior of Brazil. He derived from it a good many interesting results, especially to the knowledge of Geographical Distribution. Such are the great extension of the range of the anurous genus Prostherapis among Batrachia, of Anolis and Scartiscus among lizards, and of Rhynchonyx and Dirrhox among snakes. The rediscovery of a few species brought from the same region a half-century ago by the Austrian Johann Natterer is of considerable interest. Such are the species *Paludicola nattereri* and *Philodryas nattereri* Steind. Other rare species only seen in this collection for the second time are the *Rhynchonyx ambiniger* Peters, *Rhadinæa occipitalis* Jan., *Leptognathus turgida* Cope, and *Scartiscus caducus* Cope. The number of species known and previously unknown is as follows:

	New.	Total.
Batrachia	9	18
Lacertilia	0	15
Ophidia	3	29
	12	62

The Relative Weight of the Brain of Regulus satrapa and Spizella domestica compared to that of Man.—In the notices given by different writers on the relative weight of the brain to that of the body in different animals man has been given the foremost position. Thus, Landois[1] says the elephant has *absolutely* the heaviest brain, but man has *relatively* the heaviest brain. Surely this writer must have overlooked the little golden-crested kinglet and chipping sparrow, as the following facts seem to indicate. Two adults of the above-named specimens, which were taken in their native habitat last summer, were weighed with a view of comparison, with these results:

	Body.	Brain.
Golden-crested kinglet (*Regulus satrapa*)	$97\frac{1}{4}$	$4\frac{3}{10}$
Chipping sparrow (*Spizella domestica*)	$173\frac{1}{2}$	$7\frac{1}{2}$

Designated in grains.

As generally stated, man's brain weighs $\frac{1}{40}$ of that of the whole body. So far as the above figures show, the comparison bears out the following: the kinglet's brain weighs $\frac{1}{22}$, the sparrow's brain $\frac{1}{23}$, or nearer $\frac{2}{45}$, of that of the entire body respectively, the kinglet consequently having *relatively* the heaviest brain.—*Joseph L. Hancock, Chicago, Ill.*

Zoological News. PROTOZOA.—Dr. A. C. Stokes, of Trenton, N. J., describes eleven new species of American fresh-water Infusoria in the February number of the *Journal of the Royal Microscopical Society*, illustrating the same with a plate. Dr. Stokes thinks that identical species of Infusoria are not often found in the fresh waters of both the Old and the New Worlds, in which he will not receive the unanimous support of other workers in the same field.

[1] Landois, Phys., second ed., p. 706.

So-called eyes have often been described in the Protozoa. The latest instance is that of *Gymnodinium polyphemus*, described by Pouchet at a recent meeting of the French Academy. In this species of Flagellate there is described a strongly-refringent lens seated in a cup of black or red pigment. The lens arises from the fusion of several refractive globules and the pigment-layer or choroid from the similar coalescence of pigment-granules. The animal, in swimming, always moves "eye" forwards.

Sponges.—Students of the sponges are under a heavy debt to Dr. G. C. J. Vosmær, who has just completed the volume on the Porifera in Bronn's "Klassen und Ordnungen der Thierreichs." This work forms the only general account of the sponges, and will form a valuable book in the library of every naturalist.

Carter claims that the sponges recently described from the fresh-water fauna of Central Europe and Southern Russia as belonging to the genera Dosilia and Ephydatia in reality are members of the genus Carterius originally described by Mr. Potts from Fairmount Park, Philadelphia.

Cœlenterata.—The reef-corals of the "Challenger" Expedition are described in vol. xvi. of the Reports by J. J. Quelch. The collection contained two hundred and ninety-three species, seventy-three of which, all but two from the Pacific and Indo-Pacific, are described as new. The author merges the Rugosa in the Madreporia Aporosa. Tabulæ are present in some Astræids, absent in some Rugosa; some Cyathophyllidæ have no indication of a tetrameral type, while in some Astræids the septa are not multiples of six; the rugose character of only two sizes of septa is present in some Astræidæ and absent in some Rugosæ, etc. *Manicina areolata*, an undoubted reef-building coral, was found in Simon's Bay, at a depth of from ten to twenty fathoms, and at a temperature of 65° F. Eight species of Millepora are described in an appendix.

Mr. Guppy brings forward in *Nature* some observations which tend towards the conclusion that atolls and barrier-reefs owe their appearance at the surface to a movement of elevation. Most of the coral reefs and shoals are arrested at from five to twenty fathoms below the surface, and Mr. Guppy believes that they cannot come within the range of the constructive power of the breakers without the aid of an elevatory movement. To the breakers he (with Semper) ascribes the atoll form, the convexity being towards the prevailing currents. Large atolls begin to assume their shape below the surface. He claims to have independently worked out the same conclusion to which Le Conte arrived with regard to the Floridan reefs,—viz., that a barrier-reef is caused by a belt of growing coral limited on one side by the muddiness and on the other by the depth of the water. Under favorable conditions reef-corals will thrive at depths of fifty to sixty fathoms. This accounts for the depths of some lagoons.

Echinoderms.—Messrs. Danielssen and Koren have described *Hyaster mirabilis*, an Asterid with a central dorsal appendage, generally erect, but capable of motion. The describers conjecture this to represent a larval stage of the Crinoidea, and suggest that further investigations may tend to prove that the Asteridea are developed from the Crinoidea. They also believe that all specimens of cluster-polyps yet found are mere varieties of *Umbellula encrinus*.

Fossil remains of Holothurians are rare. Pocta describes some fenestrated plates from the Cretaceous of Bohemia, which he regards as belonging to the integument of some holothurian allied to Psolus. His paper may be found in vol. xcii. of the *Sitzungsberichte* of the Vienna Academy.

Worms.—Marion describes two species of Balanoglossus in the *Archives de Zool. Exp.* (iv., 1886). One, which he calls *B. hacksi*, is from Japan; the other, *B. talaboti*, is from the Mediterranean. His descriptions are accompanied by many notes of the minute structure, but he does not express an opinion as to the systematic position of these forms. He alludes to the wide distribution of the genus as indicative of its antiquity, species being known from the North Sea, the west coast of France, the Mediterranean, Liberia, the Red Sea, Japan, the eastern coast of the United States, and Brazil. The cartilaginous support of the proboscis (Bateson's notochord) bears a marked histological resemblance to cartilage as found in the Vertebrates.

In the same number Poirier has a paper on the Diplostomatidæ, describing the structure of some of these parasites taken from the intestines of various Crocodilia. A detailed account is given of *Polycotyle ornata*, a parasite in the common alligator (*A. lucius*) of North America, which the author thinks should be placed with this family rather than with the Polystomidæ, where it had previously been placed.

Mr. E. C. Bousfield gives a full account of the habits and of the best methods of observing the genus Dero, which differs from the Naiades in having a respiratory apparatus at the end of the tail. He diagnoses seven species, of which four are new.

Mr. J. J. Fletcher has described nine new earth-worms from Australia,—seven Perichætæ, one Cryptodrilus, and one Digaster. The Perichætæ are separable into two groups, one characterized by the possession of complete circles of setæ, and by the presence of two cæcal appendages of the large intestine in segment xxvi.; the other by incomplete circles of setæ and no cæca.

The second number of the *Journal of the Trenton* (N. J.) *Natural History Society* contains an anonymous "key" to the genera and species of North American Fresh-Water Polyzoa, illustrated by a plate of figures copied from various sources.

In the same publication Dr. T. O. Stevens gives a key to the genera and species of Rotifers recently described in the extensive monograph by Hudson and Gosse. In this connection it may be noted that no sooner is this large work completed than Mr. P. H. Gosse, one of the authors, describes (*Journal Royal Micros. Society*, February, 1887) twenty-four new species of Rotifera, illustrating them by two plates.

At the Linnæan Society Mr. S. O. Ridley recently described *Lophopus lendenfeldi*, from near Sydney, N. S. W. This is the fourth species of fresh-water polyzoon on record from Australia.

Molluscs.—Part XVI. of the magnificent folio report of the Norwegian North Atlantic Expedition is devoted to the second installment of Herman Frieles's account of the Mollusca. It deals with the Pleurotomidæ, Cancellaridæ, and Brachiopods, and is illustrated by six plates. The work will prove invaluable to systematic students of the molluscan fauna of the North Atlantic.

Vol. xv. of the "Challenger" Reports is largely taken up with the Rev. R. Boog Watson's report on the Scaphopoda and Gasteropoda. About thirteen hundred species were collected. The Chitons collected by the "Challenger" were few. The really deep-sea forms belong to Leptochiton, of which four species were found, two of them new. These were taken at depths of from sixty to two thousand three hundred fathoms.

Mr. E. Heyle, in his report on the Cephalopoda of the "Challenger" Expedition, enumerates three hundred and eighty-eight species and sixty-eight genera, of which seventy-two species were met with. Thirty-two of these are described as new. None of these belong to the monster cuttles. Four new genera and one new species are established. Cirroteuthis has three species added, the largest, *C. magna*, eleven hundred and fifty-five millimetres long. In the new genus Amphitretus the mantle is fused with the siphon in the median line, so that there are two openings into the branchial sac. *A. pelagicus* was taken near the Kermadec Islands. Twenty kinds of Octopus were found, eleven of which are described as new. Ten new species are added to Sepia, and specific characters are found in the shell or sepiostaire. Two species of Taonius were found. *T. suhmi* was taken for a Clionid Pteropod by Willemoes-Suhm, and described as a new genus of Cephalopoda by Lankester.

The Marseniadæ are a family the types of which were the *Helix perspicua* of Linnæus and the *Bulla latens* of Müller. The species occur in all seas, and have the shell either altogether enveloped in the mantle or very partially exposed. Six genera and thirty-three species are recognized in vol. xv. of the "Challenger" Reports, eleven of them new.

CRUSTACEA.—Pelseneer gives a list of one hundred and ninety-seven crustaceans actually known from Belgium.

Dr. W. K. Brooks's description of the "Challenger" Stomatopods has been reprinted, with other papers, in the volume of "Selected Morphological Monographs" just issued by the Johns Hopkins University. It is a paper of one hundred and sixteen quarto pages and sixteen plates. The collections embraced only fifteen species of adults, but of these eight proved to be new. Together with these is described a new mantis-shrimp from North Carolina,—not embraced in the "Challenger" collections,—under the name *Lysiosquilla* (*Coronis*) *excavatrix*. The great value of the paper lies in its wealth of descriptions of larval forms by which Dr. Brooks has been able to rearrange the genera on a phylogenetic basis. In this connection it may be mentioned that last summer Dr. Brooks was successful in obtaining the eggs of a species of mantis-shrimp (Gonodactylus) in the Bahamas. Unlike all other crustaceans, these forms deposit their eggs, and do not carry them about with them. In this case the eggs were laid in the cavities of the coral-rock, and readily hatched in captivity.

Mr. Pascoe recently exhibited at the Linnæan Society specimens of a Balanus in which several individuals had united their shells into a common tube, and where the outer valves of each animal had lengthened, forming a series of irregular subsidiary tubes radiating from the apex of the primary one.

ARACHNIDA.—Nalepa has a long and well-illustrated paper on the anatomy of the Tyroglyphid mites in vol. xcii. of the *Sitzungsberichte* of the Vienna Academy.

TUNICATA.—M. Giard notes the finding of the Synascidians *Distaplia rosea* Della Valle and *Diazona hebridica* Forbes and Goodsir on the French seaboard.

FISHES.—M. A. Smith-Woodward has investigated the anatomy and scientific position of the Liassic Selachian, *Squaloraja polyspondyla*. Certain individuals, presumably females, are without the cephalic spine. He proposes a new family, to be placed between Pristiophoridæ and Rhinobatidæ.

Dr. Ramsey describes the common Jew-fish of Port Jackson as new, under the name of *Sciæna neglecta*, and points out the differences between it and *S. antarctica* Castlenau and *S. aquila* Lacépède, the species to which it has previously been referred. Evidence is also given that *Callionymus reevesii* is not the female of *C. curvicornis*.

Mr. Ogilby, of Sydney, describes *Pimelopterus meridionalis*.

REPTILES AND BATRACHIA.—Mr. G. A. Boulenger describes as new three South African tortoises, *T. trimeni*, *T. smithii*, and *T. fiski*, all allied to *T. geometrica*.

The taxidermist of the Victoria Museum at Jaffna, Ceylon, who died from the bite of a cobra which he presumed to be harmless, since its poison-bag was extracted, was for a while resuscitated by artificial respiration, and stated that while paralyzed by the poison he could see, hear, and feel everything, though utterly incapable of motion. Inflammation of the lungs caused his relapse and death.

Mr. G. A. Boulenger has discriminated two forms of Bombinator in Central Europe.

AVES.—Mr. Seebohm inclines to the assumption that the reason that the eggs of birds breeding in holes are white is that nature spares useless color, and he points out that there are traces of spots on the eggs of petrels and puffins, which breed in holes, a fact which tends to prove that it is only recently that they discontinued breeding in open places, like their relatives, the auks and gulls, which lay highly-colored eggs. He also points out that the females of pheasants and humming-birds, which breed in the open, are soberly colored, while the female kingfisher, who incubates concealed, is as gay as her mate.

MAMMALIA.—M. A. T. de Rochebrune has shown that the Colobi are platyrhinous, like the apes of the New World.

C. W. de Vis has described as a probably new species of tree-kangaroo a specimen obtained in the Danitree River District. It is named *Dendrolagus bennettianus*, and is stated to be more nearly allied to *D. dorianus* than to *D. lumholtzi*.

EMBRYOLOGY.[1]

The Development of the Carnivora.[2]—A. Fleischmann has lately carried out some interesting new investigations upon the development of the Carnivora, under the direction of Professor E. Selenka, in the Zoological Institute at Erlangen, on which he reports as follows:

Material was hard to obtain, in spite of the fact that cats and dogs are to be found as pets in every family. From one hundred to one hundred and fifty cats were examined weekly during the rutting periods in February and June. Later it was found possible to obtain materials from animals kept in confinement. Besides this, useful material was obtained through sportsmen from foxes and wild-cats.

A series of stages of the domestic cat was obtained by the successive extirpation of the horns of the uterus. The preservative fluid was picro-sulphuric acid, to which one-tenth per cent. of chromic acid had been added.

[1] Edited by Prof. JOHN A. RYDER, Biological Department, University of Pennsylvania, Philadelphia.

[2] Zur Entwickelungsgeschichte der Raubthiere, Biolog. Centralbl., vii., 1887, No. 1, pp. 9–12.

Fleischmann has not yet been able, in spite of great care and patience, to find the ova of the cat and dog in process of segmentation in the oviducts. The youngest ovum which he found was a somewhat oval blastosphere, upon which the germinal area was already very distinct. This was invested by a very distinct Rauber's layer of cells.

The youngest blastosphere of the cat was nearly spherical, and twelve days after the first copulation still presents the form of an oblong sphere. Through rapid growth at the poles it soon, however, becomes citron-shaped; the germinal area then forms a convex elevation on the middle third of the blastosphere.

While the blastosphere of the dog retains the two-pointed, citron-shaped form, that of the cat retains that form for only a very short time, and gradually becomes barrel-shaped, in that the points of the blastosphere are pressed inward by mutual pressure in the successive sections of the uterine cornua, so that the ends of the growing blastospheres are only feebly conical. The flattened extremities of the blastosphere are not undergrown by mesoderm, and therefore no vessels are developed in that portion of them. At the outer margins of the flattened ends of the barrel-shaped ovum there is a delicate reticulum formed of elevations of the ectoderm, which has apparently arisen by pressure of the ends of the hollow ovum upon the folds of the uterine mucous membrane.

Around the entire germinal area and at the opposite side of the blastosphere, on the twelfth day, there are already formed small projections and elevations of the ectoderm, which serve to attach the ovum to its nidus. Before the allantois has reached any considerable dimensions the subzonal membrane has thrust out villi in all directions, and into these grows the connective tissue supporting the outer vascular layer of the allantoic sac.

The primitive groove is formed in the germinal area at right angles to the long axis of the blastosphere; the same direction is assumed by the medullary groove. At about the sixteenth day the entire germinal area changes the direction of its axis to one parallel with that of the axis of the ovum, a condition which the embryo maintains until birth.

In the primitive streak the mesoderm is formed exclusively from the outer walls of the primitive groove; in many sections one sees the mesoderm proliferating outward from the sides of the primitive streak between the two primary embryonic layers, and numerous cleavage figures indicate rapid growth in this region. The entoderm is always distinctly marked off from the mesoderm, and the author could not obtain clear proof of the entoblastic origin of the mesoderm. Even at the anterior end of the medullary groove the mesoderm is always sharply marked off from the other layers; a heaping up of the mesoderm on the entoderm as described by E. van Beneden is not apparent.

The mesoderm is characterized in well-preserved germinal areas, from eleven to thirteen days old, as a solid mass of cells, which is composed of several layers of cells under the germinal area, but consisting, outside of the latter, of but a single layer of cells.

The cœlom first appears as clefts in the mesoblast outside of the germinal area, and is pushed in under the latter at a later period.

A chordal canal is always developed, and opens at a number of points into the cavity of the umbilical vesicle or yelk-sac; and opening of this canal into the anterior end of the primitive streak was not discovered. Only in an advanced embryo, with ten somites, could a slight ectodermal depression be discovered at the anterior end of the primitive streak, but this was closed below by a máss of cells.

In front of the medullary groove lies a completely closed mass of mesoblast; the interamniotic pore, described by E. van Beneden and Julin, was not observed in young germinal areas.

The anterior amniotic fold in the cat, dog, fox, and mole is not covered by mesoderm, but consists wholly of ectoderm and entoderm. It follows from this that there is found a proamnion not only in Rodents, Bats, and Marsupials, but also in Carnivora and Insectivora, from which it may be concluded that it is a structure common to the Mammalia. The significance attached to it by Van Beneden the author cannot share.

The Wolffian duct does not arise as a solid cord of cells, but, as the author observed in the Duck, as a diverticulum of the cœlom; that the ectoderm takes part in the formation of the Wolffian duct was not established.

As respects the formation of the maternal placenta, the author fully confirms the statements of Bischoff, that the villi of the chorion grow into the uterine glands, destroying the latter.

PHYSIOLOGY.

Experiments with Pig Feeding.—In this Bulletin only a small part of the details of the experiment are given. A full account will appear in the Annual Report for 1886.

The experiments were undertaken—

1st. To produce flesh at least expense;

2d. To produce flesh most rapidly, expense not being considered;

3d. To produce most edible meat, time and expense not to be considered.

Early in March eight sow pigs were selected and put in pens as follows: Pen 1, two Berkshires and one Poland China; Pen 2, two Poland Chinas and one Berkshire; Pen 3, two Berkshires. They were not doing well when put up, and were fed until April 27 before the experiment was begun. The food from this time consisted of the following: Pen 1 (cheap food), corn meal cooked with twice its weight of skimmed milk, giving a nutritive ratio of 1 : 5; Pen 2 (rapid fattening), pea meal cooked with twice its weight of skimmed milk, giving a nutritive ratio of 1 : 2.6; Pen 3 (for lean meat), equal parts corn meal and pea meal cooked with an equal weight of whole milk, giving a nutritive ratio of 1 : 3.6.

The nutritive ratio of the rations given the second lot is very narrow, and that of the third, also quite narrow.

On several occasions lack of food compelled the substitution of raw whole corn for meal and corn meal for pea meal; but the time was so short and consequently the amount of food not properly in the ration thus consumed was so small that it could not materially affect the results.

The experiment extended through ninety-two days. The weight of the pigs and the gain in weight for each interval between weighings are shown in the following table:

		April 27, at Beginning.	June 8, 42 Days.	June 16, 8 Days.	June 23, 7 Days.	June 30, 7 Days.	July 8, 8 Days.	July 15, 7 Days.	July 22, 7 Days.	July 28, 6 Days.	Total Increase in Weight.	Average Gain per Pig per Day.
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Pen 1...	Weight........	212	450	504	532	560	600	638	642	655		
	Increase......		238	54	28	28	40	38	4	13¾	443¾	1.61
Pen 2...	Weight........	194	434	476	520	540	600	600	606	629½		
	Increase......		240	42	44	20	60	0	6	23½	435½	1.59
Pen 3...	Weight........	192	366	400	432	438	462	474	500	496½		
	Increase......		174	34	32	6	24	22	26	—3½	304½	1.66

Those fed upon corn meal and skimmed milk gained in flesh the most steadily. During the hot weather in July they all had variable appetites and gained little in flesh; those in Pen 3 lost three and one-half pounds during the last six days.

By dividing the experiment into two sections of forty-two days each (for convenience in calculation, leaving out the eight days from June 8 to 16, in the middle), it will be seen that much the larger part of flesh was laid on during the first half of the trial:

	Pen 1.		Pen 2.		Pen 3.	
	First 42 Days.	Last 42 Days.	First 42 Days.	Last 42 Days.	First 42 Days.	Last 42 Days.
Gain in flesh—Pounds......	238	151¾	240	153½	174	96½

The cost of the food eaten by the pigs in Pen 1 and in Pen 2 was greater during the last than during the first forty-two days,—*i.e.*, more food was consumed to produce the smaller weight of flesh. The third lot ate more food during the first forty-two days, but gained nearly twice as much flesh as during the last forty-two days. The following table exhibits the cost of the food consumed during these two periods and the cost of the food required to produce one pound of flesh:

	Pen 1.		Pen 2.		Pen 3.	
	First 42 Days.	Last 42 Days.	First 42 Days.	Last 42 Days.	First 42 Days.	Last 42 Days.
Cost of food eaten ..	$7.96	$9.99	$13.56	$14.05	$17.18	$14.15
Cost of food to produce 1 lb. of flesh..	0.0293	0.0645	0.0565	0.0918	0.0987	0.1505

At the average price per pound paid for swine for slaughtering, it is seen that during the early part of the trial, and with the first ration only, was the feeding profitable.

The second ration produced flesh but little more rapidly, and, taking the whole trial, produced less than did the first ration, although the former was designed for that purpose. Whether the object sought by the third ration was accomplished could not be told without slaughtering the animals. For this purpose the pigs were all slaughtered at the close of the experiment and the parts weighed separately, and, with the carcass of one pig from each pen, the lean meat and fat were separated to determine the per cent. of each.

In the following table are shown the weights of the different parts of the carcass and the per cent. of lean meat in ham, shoulder, and side:

One Pig from	Weight of								Per cent. of Lean Meat in			
	Whole Carcass.		Hams.		Shoulders.		Sides.		Hams.	Shoulders.	Sides.	The 3 Parts.
	Lbs.	oz.	Lbs.	oz.	Lbs.	oz.	Lbs.	oz.				
Pen 1 ...	215	8	41	8	44	8	82	0	63.9	67.4	34.1	55.13
Pen 2 ...	193	0	42	8	42	0	71	8	61.8	61.9	29.0	50.90
Pen 3 ...	200	4	38	2	49	12	71	8	56.1	50.5	25.9	44.17

The corn meal and skimmed milk was found more valuable for the production of lean meat than the ration selected especially for this purpose. Not only did it cost less to produce it, but a larger quantity was produced in a given time.

In this experiment the corn meal and skimmed milk proved the best ration for all the purposes for which the experiment was undertaken.—*Report of Ohio Agricultural Experiment Station, December*, 1886.

PSYCHOLOGY.

Sex in Government.—The task which those persons have undertaken who desire to change the present relations of women to government in this country is a formidable one. We refer to the woman-suffrage movement. This journal does not enter the domain of politics; but the relations of the sexes have a history far older and deeper than human government, and, as a phenomenon of Nature, they fall within our scope.

To those who have studied the sex problem from the scientific stand-point, the doctrine that the sexes are thoroughly distinct mentally as well as physically goes without saying. That the different functions imposed on each by Nature for countless ages should produce characteristic mental peculiarities follows from all laws of mental evolution. And those of each sex who have had opportunities of studying the other probably agree that such is the fact. A different opinion could only be entertained by persons whose opportunities have been small, or by persons who are themselves not normal types. The plain facts are these: The function of child-bearing has long since incapacitated the female sex for a longer or shorter part of her life from taking any considerable share in the labor necessary for support and defence. Her maternal instinct, apart from child-bearing, is still further destructive of success in these directions. Hence these labors have been undertaken by the male, who is not only free from these disabilities, but has additional adaptations for such work. The result of this division of labor has been to develop the distinctive qualities, and the latter have caused in turn still further divergence of function. It is demonstrated that the sexes of civilized man are more diverse than those of savage and primitive man, both physically and mentally.

The practical question is, Do the peculiarities of women incapacitate them from taking part in government? To answer this question we must examine the nature of the social—and in so far political—contract under which the sexes co-operate. We begin at the beginning. Woman is physically necessary to man. Man is necessary to woman for support and defence. On this basis the superstructures of civilization rest. Exceptions to this law are relatively few and of but temporary duration. Primitively, then, woman was more or less of a slave to man, much as weaker men were to stronger men. The evolution of the moral qualities has of course ameliorated the condition of the weak, and especially that of woman. The present advanced position of woman rests entirely on a foundation composed of the moral qualities of the man. Should these qualities fail her, her position reverts to its primitive stage. Under our present system, should she be treated barbarously by one man, she can call in the aid of other men for her protection. And this she is very sure of getting if her cause is good, for the administration of justice is one function of government.

Let us suppose that woman should share equally with man the administration of justice. Could she execute her decisions in case of the opposition of men? Not if that opposition should be sufficiently strong. But supposing that a majority of men were on her side, would women stand as good a chance of justice from their own sex as from men? Knowledge of women answers in the negative. We think women generally would prefer to trust men for justice in preference to women. It is evident, then, that in those departments of government which most concern women, their aid is unnecessary. We do not touch on the many questions of government "support and protection," into which women generally do not care to enter.

The primitive reason why men protect and support women remains in as full force to-day as it ever did, and through it the latter get more than justice. And if the diversity of sex characters continues to increase as it has been doing, these reasons will grow stronger instead of weaker. We see no evil in such a prospect. The passion, emotion, or sentiment of love is a great civilizer. Like the lower creation, man puts on his best dress under its influence. No greater evil can befall society than the undervaluation of this sentiment. The slurs upon it, which are so common in society and in the press, come from persons who either do not understand the order of nature, or who are forbidden by some sinister destiny from conforming to it.—*C.*

Immortality of the Personal Consciousness.—A symposium on this subject was recently published in the Easter number of the *Christian Register* (Unitarian) periodical of Boston. Eighteen scientists, all American excepting one (Dr. A. R. Wallace, now in this country), sent short articles expressing their views on the following three questions, propounded by the editor of the *Register:* "1. Are there any facts in the possession of modern science which make it difficult to believe in the immortality of the personal consciousness? 2. Is there anything in the discoveries of science which would support or strengthen the belief in immortality? 3. Do you consider the question beyond the pale of science altogether?"

The replies are various, and may be classified as follows:

1. The evidence from science is opposed to a belief in immortality (4).

A. No affirmative evidence mentioned. Leidy, Ward, Newcomb.

B. Immortality a gift of God. T. S. Hunt.

2. Agnostic (1).

E. S. Morse.

3. Science not unfavorable (8).

A. No affirmative evidence mentioned. Gray, Lesley, Dana, Gould.

B. Evidence derived from revelation. Young, Cook, Hill, Barnard.

4. Evidence from science affirmative (5).

A. No evidence cited. A. Hall.

B. Evidence psychophysical. Pierce, Cope.

C. Evidence spiritualistic. Wallace, Coues.

MICROSCOPY.[1]

EYES OF MOLLUSCS AND ARTHROPODS.[2]

Preparation of Young Pectens from 1–3 mm. long. I. MOLLUSCS.—1. Specimens are placed in a mixture of equal parts of sublimate and picro-sulphuric acid. After ten or fifteen minutes they are washed in thirty-five per cent. and seventy per cent. of alcohol.

2. The shells are then opened and the mantle dissected out with needles. Thus treated, the shape of the mantle is well preserved, whereas if removed before hardening it becomes much coiled and twisted.

3. Each mantle edge may be cut, according to its size and curvature, into three or four pieces, and these will then lie sufficiently straight for convenient sectioning.

It is necessary to use a different reagent for nearly every part of the eye.

The Rods.—Chromic acid gives the most varied results according to the strength, time of action, and temperature of the solution, or by various combinations of these three. For instance, one-twentieth to one-fifth per cent. for thirty to forty hours failed to give any conception of the structure of the rods, while other parts of the retina, and of the eye itself, were well preserved; but when allowed to act for half an hour at a temperature of from 50° to 55° C., perfectly preserved rods with their nervous net-works are obtained, while, on the other hand, the remaining tissues become so granular and homogeneous as to be unfit for study. This treatment allows the rods to be removed in flakes and their ends examined without the aid of sections. *It is only in this way that the axial nerve-loops can be observed.*

The Lens.—The lens is best prepared for sections by either sulphuric or picro-sulphuric acid; by the first reagent its shape is best retained, and the lens itself is less liable to be drawn away from the surrounding tissue; the latter reagent, however, brings out more sharply the configuration of the cells and allows a better stain of the nuclei to take place.

The Retinophoræ.—The retinophoræ are well preserved by nearly all the reagents; but in sublimate, in picric acid, or in

[1] Edited by C. O. WHITMAN, Ph.D., Milwaukee, Wisconsin.

[2] Dr. Wm. Patten, Mitth. a. d. Zoöl. Station z. Neapel, vi. p. 733, 1886.

their combinations, they become slightly granular, and remain so closely packed that it is difficult to distinguish the cell boundaries. Chromic acid, one-fifth per cent. for three or four days, contracts the cells and gives preparations in which the boundaries and general arrangement of the retinophoræ are easily studied.

Sections of the Eye.—In order to obtain the best sections of the adult eye with *all* the parts in the most natural position, it is necessary to treat them first with one-tenth per cent. of chromic acid for half an hour, then in one-twentieth per cent. for twenty-four hours; one-tenth per cent. for twenty-four hours, and finally one-fifth per cent. for forty-eight hours or more. Next to this method, it appears that solutions of sulphuric acid (twenty drops to fifty grammes of water) give the best preparations (for sectioning), of everything except the rods.

The double layer of the sclerotica and the fibres penetrating it can be seen in sections of eyes treated twenty-four hours in one-fifth per cent. chromic acid.

Maceration and Dissection.—The *pigmented epithelial cells* of Pectens' eyes and the cells of the *cornea* are easily isolated by treatment with Müller's fluid or bichromate of potash one-half per cent. for two or three days. For the maceration of all other elements weak chromic or sulphuric acid is used. For the outer ganglionic cells, which are very difficult to isolate, maceration in one-fiftieth per cent. chromic acid gives excellent results, after previously fixing the tissue in one-fifth per cent. for a few minutes.

For the *retinophoræ*, one-twentieth per cent. for four or five days proves very useful.

Sulphuric acid, five drops to thirty grammes of sea-water, gives the best results for the nerve-endings in the retinophoræ (not in the rods) and for the nervous inner prolongation of the outer ganglionic cells.

In order to isolate pieces of the cornea with the subjacent *pseudo-cornea* and the circular fibres on the outer surface of the lens, it is better to macerate the eyes in sulphuric acid as given above. The same treatment retains to perfection the natural shape of the lens, which may then be isolated and its surface studied to advantage.

It is necessary for the study of the *circular retinal membrane*, the *septum*, and the *retina* itself, to isolate the latter intact. Maceration in chromic acid either makes the retina too brittle or too soft, while the axial nerve-fibres remain so firmly attached to the retina that it is difficult to isolate it without injury. But this may be easily and successfully done by maceration for one or two days in the sulphuric acid solution. By this treatment the *retina*, together with the *septum* and *circular retinal membrane*, may be detached entire.

Surface views of the retina show the peripheral outer ganglionic cells. The *argentea* may be very easily separated in large sheets by macerating for four or five days in bichromate of potash of one per cent.

Sulphuric acid is a most valuable macerating as well as *preservative reagent.* In weak solutions (forty drops to fifty grammes) entire molluscs, without the shell, have been kept in a perfect state of preservation for more than six months. For cilia and nerve-endings it is exceptionally good.

The eyes of Arca and Pectunculus may be macerated either in Müller's fluid or chromic acid. Undiluted Müller's fluid in twenty-four hours gives more satisfactory preparations than a weak solution which is allowed to act for a longer period. Chromic acid, one-fifth per cent. for ten or twelve days, gave most of the preparations from which the drawings of the nerve-endings were made. A few drops of acetic and osmic acid added to distilled water give a very energetic macerating fluid for the epithelium of marine molluscs. Such preparations led to the discovery of the very delicate outward continuations of the pigmented cover-cells in the compound eyes of Arca.

II. ARTHROPODS.—In order to demonstrate the presence of the *corneal hypodermis* in the faceted Arthropod eye, and the connection of the so-called "rhabdom" with the crystalline cone cells, it is necessary to resort to maceration. In most cases it is hardly possible to determine these important points by means of sections alone.

The ommateum of fresh eyes, treated for twenty-four hours or more with weak sulphuric or chromic acid, or in Müller's fluid, may be easily removed, leaving the corneal facets with the underlying hypodermis uninjured. Surface views of the cornea prepared in this way show the number and arrangement of the corneal cells on each facet. In macerating the cells of the ommateum it is not possible to give any definite directions, for the results vary greatly with different eyes, and it is also necessary to modify the treatment according to the special point to be determined. It is as essential to isolate the individual cells as it is to study cross and longitudinal sections of the pigmented eyes. In determining the number and arrangement of the cells and the distribution of the pigment the latter method is indispensable; it should not be replaced by the study of depigmented sections, which should be resorted to in special cases only.

In *fixing* the tissues of the eye, it is not sufficient to place the detached head in the hardening fluid; the antennæ and mouth parts should be cut off as close to the eye as possible in order to allow free and *immediate* access of the fluids to the eye. When it is possible to do so with safety, the head should be cut open and all unnecessary tissue and hard parts removed. With abundant material, one often finds individuals in which it is possible to separate, uninjured, the *hardened* tissues of the eye from the cuticula. This is of course a great advantage in cutting sections. The presence of a hard cuticula is often a serious difficulty in sectioning the eyes of Arthropods. This difficulty can be diminished somewhat by the use of the hardest paraffine, and by placing the broad surface of the cuticula at right angles to the edge of the knife when sectioning. Ribbon sections cannot be made with very hard paraffine, but it is often necessary to sacrifice this advantage in order to obtain very good sections.

SCIENTIFIC NEWS.

—Over a year ago the announcement was made that a human skull was found near Worcester, Mass., in such a position with regard to the bones of a mastodon as to indicate that they were contemporaneous. Regarding the authenticity of the mastodon bones there was no doubt, but certain facts seemed to indicate that the human skull was a "plant," but one which was rather skilfully performed. It is now announced that those in Worcester who have been investigating the affair are convinced that the skull was placed where it was found by some one who had a slight knowledge of archæology. As absolute proof is as yet lacking, no names are mentioned, but circumstances point strongly towards a person who is believed to be capable of such a fraud.

—Prof. Herbert W. Conn, of Wesleyan University, will have charge of the biological instruction at the summer school at Martha's Vineyard during the present season.

—*Random Notes on Natural History*, a small monthly magazine started in 1884 by Southwick & Jencks, of Providence, R. I., has been discontinued. The three volumes published contain many notes on the natural history of Rhode Island.

—The announcement has already been made in these pages that early in the present year Ginn & Co., of Boston, were to start a *Journal of Morphology*, under the editorial charge of Dr. C. O. Whitman. We recur to the subject to say that the first number will be issued some time during the present month, and to call the attention of all persons interested in the anatomy, histology, or development of animals and plants to the claims of this journal. It will be the endeavor to make it the equal and the representative in America of such periodicals in Europe as the *Zeitschrift für wissenschaftliche Zoologie* and the English *Quarterly Journal of Microscopical Science*. The name of the editor is a guarantee that the contents will be of the highest character. The plates will be fully equal to those of the best of the foreign journals. Such a journal has long been a desideratum, and it is the duty of every American student to support it.

The subscription price for the present has been fixed at six dollars per annum.

—Dr. A. T. Bruce, one of the more promising of the younger American zoologists, died at Cairo, Egypt, February 11, 1887. He was a graduate and for a while an assistant at Princeton College, and then pursued post-graduate studies at Johns Hopkins University, where he received the degree of Ph.D. His health had become impaired by overwork, and at the time of his death he was on his way to Japan. He died of local fever, which his constitution was not strong enough to resist. One of his former instructors writes, "It is a great loss to me; he was always a charming fellow." He had published only preliminary results of his studies, which were chiefly in the line of the development of Arthropods,—spiders, Lepidoptera, Orthoptera, and, with Dr. Brooks, Limulus.

—The announcement is made that those desiring aid for scientific research from the Elizabeth Thompson fund should make early application to the secretary of the trustees of the fund, Dr. C. S. Minot, Harvard Medical College, Boston, Mass. All applications should state clearly the amount wanted, the purpose for which wanted, and other details, to aid the committee in making their awards. The awards will probably be made in May.

—S. H. Vines, the eminent English botanist, has been given the degree of D.Sc. by the University of Cambridge, England.

—The Academy of Sciences of Berlin has recently made its awards for the furtherance of science, among which may be noted three hundred and seventy-five dollars to Karl Brandt to continue his studies of the Radiolaria, two hundred and fifty dollars to Dr. Ludwig in furtherance of his Echinoderm investigations, and nine thousand dollars in aid of various scientific publications, most prominent of which are Dohrn's "Zoologisches Jahresbericht" and Dr. Taschenberg's "Bibliothek."

—In a recent number of the *Natural History Transactions* of the Northumberland, Durham, and Newcastle-on-Tyne Societies occur twenty letters from the late Charles Darwin to Albany Hancock relating to the barnacles. They are interesting reading, especially since they display the caution with which Mr. Darwin worked.

—For five years the Women's Education Society of Boston has supported the Marine Laboratory at Annisquam, of which frequent mention has been made in these pages. Recently a meeting was held in Boston, at which the further continuance of the laboratory was discussed. Remarks were made by and letters read from those who were acquainted with the work done, and it was the general sense of the meeting that the laboratory be placed on a permanent footing, with paid assistants and every facility for elementary instruction, as well as original investigation. A board of directors was elected and various committees appointed to take action as to finances, location, and other matters.

—Dr. J. W. Fewkes has been in California during the present winter, engaged in studying the Medusæ of the Pacific.

—Dr. J. S. Kingsley, of Malden, Mass., will have a small laboratory for original biological research at Salem, Mass., during July and August of the present year.

—The *American Monthly Journal of Microscopy* has greatly changed its typographical appearance with the present volume. Under the editorship of Professor H. L. Osborn it is becoming more scientific and valuable.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences.—March 14.—Prof. W. P. Trowbridge presented notes upon the "Laws of Fatigue and Rest in Animal Mechanics, as applied to Boat-Racing."

March 28.—The following paper was announced: "The Fauna and Flora of the Trias of New Jersey and the Connecticut Valley" (illustrated with specimens and drawings), by Dr. J. S. Newberry.

Biological Society of Washington.—March 19.—Communications: Mr. L. O. Howard, "A Rock Creek Philanthropist;" Mr. Charles Hallock, "Trans-Continental Thoroughfare of the Moose," with some description of its habits; Dr. Tarleton H. Bean, "American and European Work in Deep-Sea Ichthyology;" Mr. F. A. Lucas, "The Occurrence of Lepidoptera at Sea;" Capt. Joseph W. Collins, "Some Novel Facts in the Natural History of the Codfish;" Dr. C. Hart Merriam, "Contributions to North American Mammalogy—Description of a New Mouse from New Mexico."

April 2.—Communications: Dr. Theobald Smith, "Quantitative Variations in the Germ Life of Potomac Water during the Year 1886;" Dr. Edward Eggleston, "Queries concerning Certain Plants and Animals known to the earliest Colonists of North America;" Prof. Otis T. Mason, "Representations of Animal Forms in Eskimo Art;" Mr. F. W. True, "The Blackfish of our Southern Waters;" Dr. H. G. Beyer, "The Action of Caffeine on the Kidneys."

Boston Society of Natural History.—March 16.—Professor W. M. Davis spoke of the value of classification as a guide in geographic investigation. Professor F. W. Putnam spoke of perforated stones from Indian graves of California, illustrating his remarks by numerous specimens.

Essex Institute.—February 21.—Professor Frederick W. Putnam gave an account of the explorations of the Peabody Museum of Archæology in the Turner group of mounds in the Little Miami Valley. A partial account of these explorations appeared in the December number of this journal.

March 21.—Mr. W. D. Northend spoke on the settlement of Massachusetts Bay Colony.

American Committee of International Congress of Geologists.—Meeting at Albany, N. Y., April 6. The report of the secretary (Dr. P. Frazer) of the proceedings of the committee at its Philadelphia meeting in December last was read and approved. It was agreed to recommend to American geologists for adoption the general system and scale of colors adopted by the Berlin Congress, with such minor modifications as may be subsequently agreed on, and such additions as American geology renders necessary. The sub-committees on special geology reported as follows: A paper on the Archæan was read by Dr. T. S. Hunt, and verbal discussion by Winchell, Hitchcock, and Frazer. Papers on the Palæozoic were read by Prof. J. J. Stevenson, Prof. H. S. Williams, and N. H. Winchell (Taconic). A paper on the Mesozoic of the interior of the continent was read by E. D. Cope. Papers on the Cænozoic were read from Prof. Eugene Smith for the marine and E. D. Cope for the lacustrine regions. It was agreed to meet at some point accessible to New York a few days before the meeting of the American Association for the Advancement of Science the coming summer, the day to be fixed by the executive committee.

The former plan of preparing reports by sub-committees with separate chairmen was, on motion of Professor Cope, unanimously abandoned, and in its stead reporters were named for the seven subjects into which the geological column was divided. The reporters are charged with the duty of collecting all possible data bearing on their subject, both from within and without the committee, and presenting each what may be considered a *résumé* of the opinions of American geologists on his subject at the next meeting. In some form these reports will then be brought before the Geological Section (E) of the American Association for the Advancement of Science at its session to be held a few days after that of the American Committee, or on August 10 next.

The following are the subjects and reporters: Quaternary, Recent, and Archæology, Major J. W. Powell, Director United States Geological Survey, Washington, D. C.; Cainozoic (Marine), Prof. E. A. Smith, State Geologist, University of Alabama, Tuscaloosa County, Ala.; Cainozoic (Interior), Prof. E. D. Cope, 2102 Pine Street, Philadelphia; Mesozoic, Prof. George H. Cook, State Geologist, Rutgers College, New Brunswick, N. J.; Upper Palæozoic, Prof. J. J. Stevenson, University of the City of New York, and Prof. H. S. Williams, Cornell University, Ithaca, N. Y.; Lower Palæozoic, Prof. N. H. Winchell, State Geologist, University of Minnesota, Minneapolis; Archæan, Dr. Persifor Frazer, 201 South Fifth Street, Philadelphia.

In order that the geologists of this country should all be properly represented at the next Congress by their national committee, it is necessary that they should assist that committee as much as possible by communicating their views. They are earnestly requested to do so, and in case of their failure they will have themselves to blame if their views are overlooked.

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THE PRESENT CONDITION OF THE NATURAL SCIENCES IN SWEDEN.

BY FILIP TRYBOM.[1]

IN describing the progress of the zoological science in Sweden during the later decades, and that, too, in a country with such resources as the United States, I beg you to remember that though Sweden, the old country in the far north, was happy enough to be among the countries in which, during a comparatively early period, the sciences were cultivated, the number of its inhabitants is less than that of the State of New York alone, and that its wealth, and consequently the money which can be bestowed upon the sciences, always has been limited.

The homes of the study of natural history in Sweden have been and are still the Universities of Upsala and Lund and the Academy of Sciences in Stockholm, created by Linnæus. The predecessors of Linnæus in Upsala, viz., the Rudbecks, father and son, were both eminent zoologists for their time, but the collections they brought together were totally destroyed by fire. Linnæus and his successors, Wahlenberg included, who died in 1851, were at the same time professors of medicine and natural history, thus being obliged to spread themselves over a much too large field of work and study. As to Wahlenberg, he mostly devoted himself to botany during his long-lasting professorship. It was not until three years after his death, or in 1854, that the first professorship entirely devoted to zoology was established at the

[1] Read before the Biological Society of Washington, November 13, 1886.

University of Upsala, the first professor being W. Lilljeborg, who is now a professor emeritus, but who, despite his seventy years, still remains very active and industrious. At the University of Lund Professor S. Nilsson and many of his pupils had already been working up different branches of the Swedish fauna during the period previous to and contemporaneous with the above changes in Upsala.

In a very close connection with the Academy of Sciences in Stockholm is our "Riksmuseum" (corresponding to the National Museum in Washington). It belongs to the government, but the academy is its "Board of Regents," elects its curators, or, as they are called, intendents, etc. There are three zoological departments,—one containing the vertebrates, one the insects, and the third all the other invertebrates. Besides, there is one department for palæozoology.

Our Swedish vertebrates had been made comparatively well known and described by S. Nilsson, Sundevall, Lilljeborg, and other zoologists more than twenty or thirty years ago; the insects had been studied during the first half of the century by Gyllenhaal, De Geer, Boheman, Zitterstedt, Dahlborn, and others. Compared with the insects, other classes of the invertebrate animals were considerably neglected; but S. Lovén had written his "Index Molluscorum litora Scandinaviæ accidentalia habitantium;" Düben, together with the Norwegian zoologist Koren, had edited their "Review of Scandinavian Echinoderms," etc. The zoological collections in the "Riksmuseum" were growing fast, and in Lund Professor S. Nilsson had brought together good collections of our vertebrates, but in Upsala the zoological museum belonging to the university was in a bad condition when Lilljeborg was elected a professor. Meanwhile, there were, and are still, some old valuable collections, as the types of Linné's "Museum Ludovicæ Ulricæ," all with his own labels, and of the insects described by Gyllenhaal, etc. The above-mentioned Linnæan types consist mostly of molluscs, echinoderms, fishes, insects, and corals. Professor Lilljeborg, although he had very small appropriations at his disposal, established nearly a new museum of all classes of our Swedish animals during his professorship.

When the Swedish Arctic expeditions were first started new impulses were given to zoological studies and researches. The leaders, always accompanied by a staff of younger and enthusiastic naturalists, brought home very large zoological collections, and in that way our "Riksmuseum" grew. I believe it now contains the most complete series of Arctic European and Asiatic invertebrates, especially of the marine ones.

S. Lovén was the first to start these expeditions, going, as he did, to Spitzbergen in 1837. Professor O. Torell made four expeditions to Iceland, Spitzbergen, and Greenland, the last one in 1861. The expeditions of Nordenskiold of more recent dates, following the lead of Lovén, are too well known to require any further mention.

As the first expeditions mostly were directed to Spitzbergen, the animal life of that Arctic region, through their efforts, was made thoroughly well known.

A short enumeration of the more important papers written in regard to the collections from there, so far as I now can remember them without going to original sources, may not be out of place in order to show how much these expeditions have contributed to zoological science.

The mammals of Spitzbergen have been described by Quennerstedt, Malmgren, and C. H. Andersen; the birds by Sundevall, Malmgren, and Newton; the fishes by Malmgren; the insects by Boheman and A. E. Holmgren; the spiders by T. Torell; the crustaceans by Goës, G. O. Sars, and Lilljeborg; the molluscs by Lovén and O. Torell; the Bryozoa by F. A. Smitt; the annulates by Malmgren, and some other orders of worms by Goës; the Oligochæta by G. Eisen. The geographical distribution of the animals living in the seas surrounding Spitzbergen has been treated of by Malmgren, Lovén, and Quennerstedt.

As to the zoological results of Nordenskiold's later expeditions to the Arctic Asiatic seas and to Siberia during the years 1875, 1876, and 1878–80, I only may mention that of his companions Stuxberg has worked up the myriapods, the crustaceans, the echinoderms, and the general distribution of animals in those waters, while Théel has reported on the birds, worms, and holothurians; Nordquist, another companion of Nordenskiold, has written up the mammals. Most of the insects which I collected in Siberia, 1876, were described by Professor J. Sahlberg, in Helsingfors, who during the same year travelled in the land of the exiles. The insects collected during the other expeditions have been treated of by Māklin and Chr. Aurivillius; Collembola by T. Tullberg; spiders by L. Koch, Kramer, and Neuman; molluscs by Leche, Carl, Aurivillins, and Westerlund; worms by Wiren; and Tunicata by Swederus.

In order to investigate the animal life of the seas surrounding our coasts, the government detached a gunboat, and paid the expenses and salaries of the scientists for a series of years, the last being 1879. The zoological exploration of our seas and inland waters, as well as that of our woods and fields, is, furthermore, encouraged by means of yearly contributions of money by the Academy of Sciences in Stockholm and by the universities, this money being the interest of funds donated or willed by private persons or special appropriations by the Diet. As travelling in our country is cheap, and as the expeditions mostly are limited to a few months, the amounts fixed for each party are usually rather small. Larger amounts appropriated for travels for scientific purposes in foreign countries, and the rules and conditions in regard to these, are very different for every one of them. As these usually are the objects of considerable competition, they are distributed alternately between the different sciences. Thus, to mention an example, my present visit to North America, with the object of studying the fisheries of this continent, is due to such a stipend awarded by the Academy of Agriculture, which virtually represents an administrative department of economy. This stipend is disposed of alternately by the academy just mentioned, the Academies of Sciences and Antiquities, and the two old universities.

About ten years ago a Swedish zoologist, Dr. G. Eisen, travelling by means of the same stipend, went to California, whence he sent home his report and the different collections made, while remaining there himself. The last zoologist to receive it was Dr. C. Bovallius, who spent it in travels through Centro-America.

The studies of our Swedish salt-water animals have been greatly facilitated of late by the establishment of a permanent station or headquarters for these studies in a locality well suited for the purpose, being, as it is, sheltered by islands in such a way that dredgings can be done almost at any season and weather on different kinds of bottom and in various depths, up to one hundred fathoms, in a bay close to the station. The amount needed for its construction—I believe about thirteen thousand dollars—was donated by a Swedish physician living in Brazil. The yearly running expenses—being only between five hundred and six hundred dollars—are paid by the government. In the laboratory there are eight working-rooms, with tables, microscopes, and small aquaria, sufficient for about a dozen students; and if there be not zoologists enough to fill these places, botanists, geologists, or hydrographers are admitted. There, for instance, Professor Nathorst (the palæobotanist) made his experiments and investigations in regard to the impressions and tracks formed in the clay by decapods, worms, etc., most of which until recently were supposed to be fossil sea-weeds. A collection of marine animals from the coast province, where the station is situated, is still in progress of formation, but a very good and complete collection of this kind has already for many years been in existence in the zoological department of the Gothenburg Museum.

Up to the seventh decade of this century only a few of our Swedish zoologists were studying comparative anatomy, histology, or embryology; Clason in Upsala, G. Retzius in Stockholm, Lindgren in Lund,—all three professors of anatomy in the medical faculties,—and S. Lovén being nearly the only ones cultivating these branches. Since that time, or at least since T. Tullberg was appointed a professor in Upsala, succeeding Professor Lilljeborg, anatomy has been carried on as the main branch of the zoological studies at that university. The government has made appropriations for the establishment of a special anatomical department with its own teacher, and this department has now an extensive collection of anatomical preparations, partly in alcohol, but mostly consisting of dried objects, as stomachs, guts, hearts, lungs, livers, kidneys, and milts, prepared according to the system of Brunetti, greatly improved by Professor Clason. About one hundred students attend the courses in anatomy and histology in this department every year. The ordinary professor lectures in two different courses, one consisting of the elements of anatomy and osteology, histology, etc., for the young medical students and for those intending to become school-teachers, the other for students intending to graduate with zoology for their main science. The average number of students attending the latter course during the last years has been sixteen. Beginning with the Protozoa, the professor lectures on that group four hours a week during one term of twelve weeks. Within each of the chief divisions of the animal kingdom he treats separately of its anatomy, histology, and embryology, winding up by giving a review of the morphological classification of the group. Therefore a student, if not having had an opportunity of attending more than one term of the lectures, will nevertheless get a fair idea of the scientific treatment of at least one group in its entirety, and of the present state of our knowledge in regard to it, as well as of how much is still to be studied and investigated; he learns to recognize the common characteristics of the animals composing the group, and to judge of the probable courses its genera and species have followed in being evolved from more generalized types.

After having graduated with the degrees of candidate and licentiate of philosophy, and before becoming doctors, the students have to publish and in an official discussion defend a treatise relating to their special science. As I have the three last zoological dissertations handy, I brought them with me to this meeting as examples. The first one, by Wiren, is about the circulatory and digestive organs of some families of Annulata; the second, by Fristedt, on the Swedish sponges, and the third, by Appelldf, about Japanese cephalopods.

At the recently established high school in Stockholm the study of zoology is carried on nearly on the same plan as in Upsala, but not to the same extent, nor with the same resources. Two young lady students—A. Carlson and C. Westling—at this high school have recently published some anatomical treatises, the only zoological papers ever written by any Swedish lady, as far as I know.

The larger and more important works published by the Swedish zoologists of late years, as, for instance, Lovén's Echinoderms, T. Torell's Spiders, T. Tullberg's Podurids and his histological treatises, H. Théel's "Challenger" Holothurians Lilljeborg's Swedish Mammals and Fishes, Thomson's Coleoptera, Neuman's Hydrachnids, P. Olson's Entozoa, etc., are more or less known on this side of the Atlantic, so that I need not mention them further. But the great work by Professor G. Retzius on the Morphology and Histology of the Ear of the Vertebrates, the most extensive Swedish zoological publication of recent date, has perhaps failed to reach many of the natural history libraries in this country, because he is a professor at an exclusively medical institution, and as this work is printed and published at his own expense, and not as a part of any public reports or proceedings. Professor T. A. Smith's book on Salmonides and Coregonides, just issued, may perhaps likewise not yet have been received here.

Before leaving our Swedish zoologists I wish to mention the work that some of them are engaged in at present. Their Nestor, Professor S. Lovén, now seventy-seven years of age, is revising the Echinoderms described by Linnæus. Professor Lilljeborg is publishing his book on the Scandinavian Fishes, and, after having finished that work, he intends to publish a volume on the Entomestraca. Théel is working on the Holothurians collected on board the United States steamer "Blake." C. Bovallius is busy with the Hyperidæ and the parasitic Isopods, C. Aurivillius with the Lepadidæ, F. Fristedt with the Sponges contained in our "Riksmuseum."

FIDDLER-CRABS.

BY J. M'NAIR WRIGHT.

MY most intimate friends at the seaside are the ill-tempered but handsome fiddler-crabs,—Gelasimus of science. I enjoy their beauty and their ability, but am no doubt cordially hated by them for my interference with their domestic affairs. There is an intensity to their action which is seldom met with among the lower inhabitants of the shore. I have watched them by the hour and have never tired. Their holes dot the beach in favored localities, and near each hole is a small heap of sand brought up from below by the industrious digger, whose cellar never seems large enough. I have noticed that there is a correspondence between the noise made in seating one's self near a hole and the length of time that elapses before the worker appears, and that his first appearance is made with extreme caution. There can be no question about his sense of hearing. A rap near the hole keeps him down a long time, conversation in the vicinity has the same effect, and then when he does venture to appear at his door, it is with the most timid air. He protrudes but a portion of his body and then carefully examines his surroundings. A sharp, shrill whistle when he is out causes him to dart in like a flash, but repeat it several times and he gains courage and now exhibits his curiosity. His whole body becomes attention. He erects himself and elevates his stalked eyes,—a better picture of listening it would be difficult to find.

It is the male fiddler that does the house-building. When undisturbed he remains below from half a minute to two minutes, and then reappears with his large claw folded close against the body and on it an armful of sand. Reaching the door, he gives the arm a quick flirt and throws the sand with considerable accuracy upon the heap. After discharging the load, the pert eyes are erected and Gelasimus looks about. If an animal's actions express anything, he certainly listens at the same time, and, in my opinion, his interest centres in the stage of the tide. I have never seen a mention of this watchfulness, but hundreds of observations have convinced me that the fiddler does keep watch of the tide. When the tide is well out he exhibits less concern, but makes his trips in and out of his hole as rapidly as possible; but as the tide comes in his actions change: the watchfulness and the appearance of listening are more marked. When but a few minutes—it may be a quarter of an hour—remain before the incoming tide will cover his home, he stops digging and makes excursions for food, which he carries to his larder below. As the tide advances these excursions are shorter. He looks before each run, and seldom fails to bring in some toothsome morsel. In this connection I have noticed three points: he is never caught by a wave as it rolls up the beach, he never comes out after a wave rolls over his dwelling, and he never stays in his burrow a wave too soon. He does not close his door with his big claw, as sometimes said. He knows too well that this is not necessary, for the first wave that rolls over his home will fill up the hole with that very sand that he has so laboriously excavated.

When the tide is well out the fiddler does not stop digging to collect food. His plan is to first build his house and then stock it with provisions. He will not, however, refuse to take any food which comes in his way, even when most busily engaged in his excavations. When the proper time comes he finds his food in the line of foam and sea-weed left by the successive waves as they come up the beach. Here he finds a fine bill of fare,—flies, mosquitoes, and the like, which are caught and left half drowned by the incoming wave. I once saw a fiddler running back to his hole and bearing a round red ball which looked like a drop of blood and which offered a brilliant contrast with his own pale tan color. I caught him at his door and took from him a living "lady-bird." Released, the crab quickly disappeared below, and there he remained a long time, evidently afraid to come out. But the need of provision and the advancing tide at length drove him out. Coming up, he found his lady-bird lying just at his door; he snatched it eagerly and scuttled backwards down the burrow to put it with his other goodies.

The muscular strength of these crabs is considerable. There is an enormous element of error in contrasting the work of any small animal with that of the "lords of creation," but it is fascinating. Imagine a man in digging to take a load of earth or sand at each shovelful which equals one-fourth his own size and weight, throw it from six to twelve feet, and continue this between two tides until he had a pile from eight to fourteen feet in height. What a Hercules he would be! I have often tried the strength of the fiddler in another way. When he is below I have laid a bit of stick or shell lightly over his hole. If this be very light, his upward rush removes it and he does not appear to have the slightest curiosity or alarm; nor is he delayed below by the darkening of his hole,—a curious fact when one considers his powers of sight. If the shell be a little larger, his first rush does not remove it, although it shakes with the shock. He retires, and is apparently alarmed, for an interval elapses before he comes up again, this time with more force. I have seen a crab thus dislodge a pebble twice the size of his body and much more than his entire weight, causing it to fly into the air two or three inches. He does not remove the obstacle with his big claw, for he immediately comes out with that loaded with sand as before. He charges against it and knocks it away with a blow like a miniature battering-ram. This covering the hole, if silently done, does not seem to alarm the crab or excite its suspicion.

The fiddler, unlike most of his relatives, is a family crab. His wife cannot dig or clean out the dwelling, for she lacks the large claw which is such a useful member in the male. She is not a gad-about. She is content to stay below, and is far less frequently seen than are the males.

The males are very pugnacious, rivalling the oft-described hermit-crabs in this respect. When two meet they almost invariably threaten each other, if they do not at once fall to blows. If the tide is almost up to their homes they seem to agree to postpone the battle, but at other times they quickly begin the fray. When the foe is in sight the crab, whose body has been close to the sand, its legs spread out, its big claw folded close against the body, at once puts its forces on a war-footing. The slender legs are drawn in, and, walking on the tips of his toes, he elevates his body high in the air and puts his large claw, at once an organ of offence and defence, at an angle of forty-five degrees. His eyes are elevated, so as to obtain a clear view, and then he flings himself towards his opponent. As he does so he draws down his eyes for safety and still further extends his big claw, with which he tries to grasp his antagonist, who, in the mean time, has been going through similar preparations. The loss of a limb is not such a serious affair to them as it is to larger warriors. The wound caused by the amputation soon scars over, and when the next molt takes place a new limb appears just like its predecessor, only smaller. At a subsequent molt it gains its proper size.

The fiddler has no feature more curious than his power of packing or doubling himself up. The door to his underground home looks scarcely larger than his square compact body, and yet, when alarmed, he goes into it like a flash. He runs to the opening and then folds down those curiously mobile eyes, packs away his eight walking-legs and his big and little claws, and disappears below. Unless you have actually watched him, you can hardly believe that the fiddler which you saw a moment before hurrying across the beach and waving his hands with those gestures which have given him his name has darted into that small opening. You are more inclined to think that, like the people in the fairy tales, he has donned his cap of invisibility and that this explains the mystery.

METSCHNIKOFF ON GERM-LAYERS.[1]

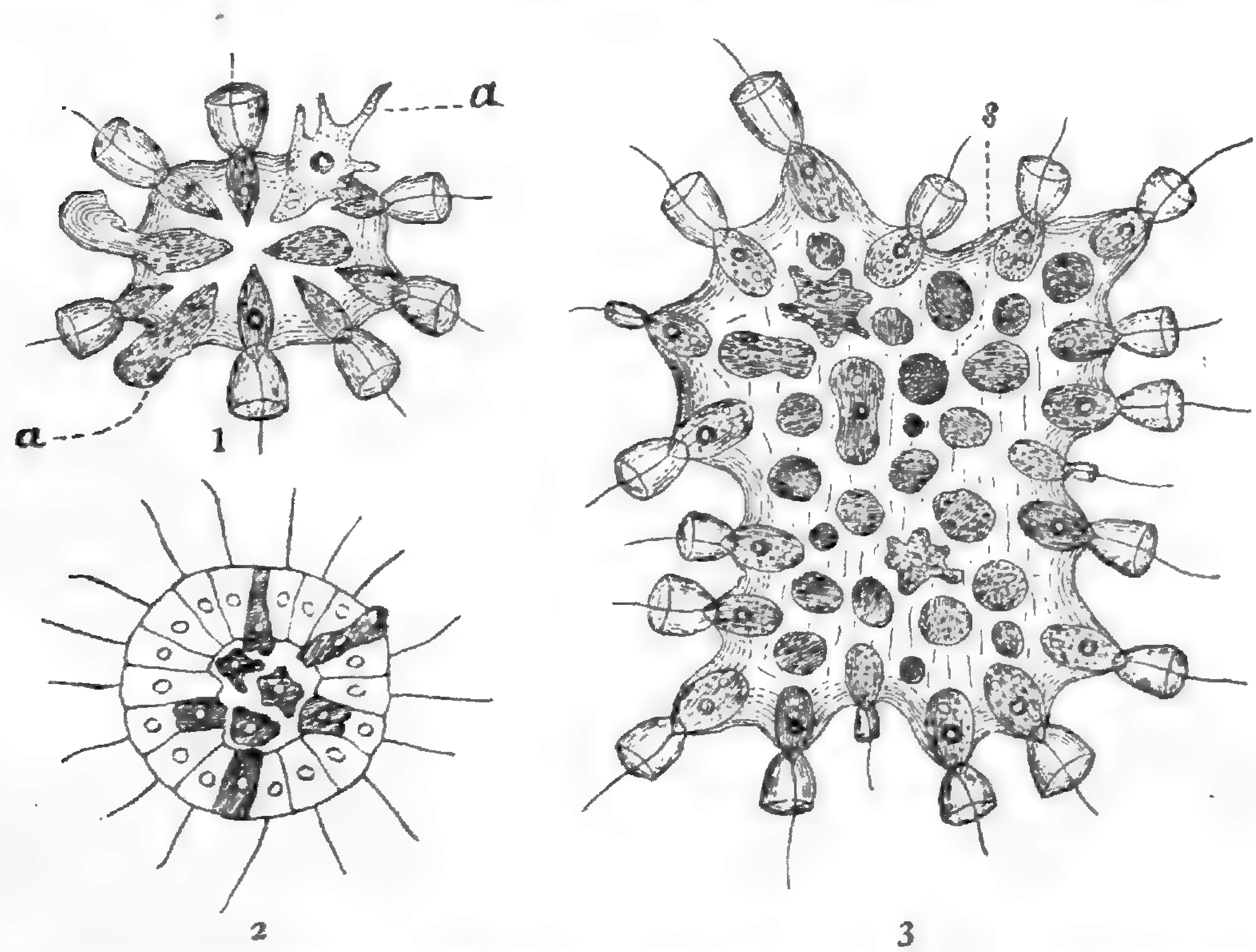
TRANSLATED BY H. V. WILSON.

(Concluded from page 350.)

IF we consider all that has been said on the theories in question, we cannot but see that they fail to establish the connection between the various embryological phenomena,—to combine them under one point of view, so to speak,—and that, moreover, they display a lack of physiological explanation. Some other theory must, then, be invented. In my studies on the Sponges (8) I very cautiously made a few remarks which, as I thought, agreed with what we knew of the way in which the endoderm was formed among the lower Metazoa, and which could be brought into harmony with the phenomena of intracellular digestion. I stated my belief that the endoderm did not appear in the beginning as a sac-like stomach with a terminal opening, such as one finds in the gastrula, but that behind these structures lay a long historic process, recorded in the formation of a solid parenchyma, in which digestion is intracellular. This parenchyma did not appear all at once, but was gradually formed from superficial blastoderm cells that migrated into the central cavity. There finally arose a two-layered parenchymella, which, by abbreviation of the embryonic process, along with the advancing differentiation of the digestive apparatus, became changed into a gastrula. At that time (1879) it was impossible for me to refer to any highly-developed Flagellate with animal nutrition. I therefore tried to find some foundation for my views in the development of Volvox, and in this connection made the following remark: "In my opinion it is time to begin looking for some low organisms in which the nutritive cells, perhaps after having taken in food, leave their usual position at the surface of the 'colony,' and come to lie within the central cavity" (p. 382). Shortly afterwards (July, 1880) Saville Kent discovered a most interesting form of Flagellate colony, which he introduced to science as *Protospongia häckelii* (20). The individuals of a colony are at first regularly arranged at the surface. Some of these assume a pronounced amœboid shape, and migrate into the interior of the mass of

[1] The numbers in this article refer to the bibliographical list appended.

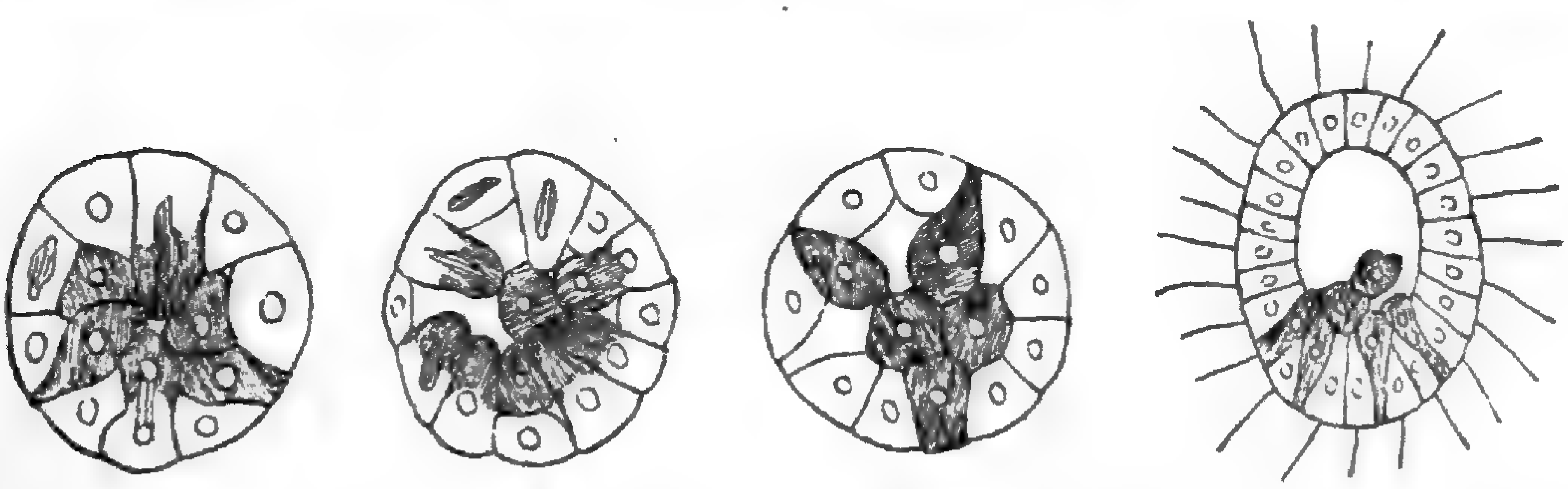
jelly, which serves to unite the members of a colony (Fig. 1, *a*). Here the amœboid individuals remain, to divide and suffer further changes, which Kent interprets as evidences of sporulation (Fig. 2, *s*). Whether the adoption of the amœboid form, together



with the migration into the jelly, is in any way connected with the state of nutrition, cannot be asserted at present, since the phenomena involved are quite unknown. In view of the fact that the sporulation is as yet an open question, I hazard a guess whether the numerous granules seen by Kent be not either bits of indigestible stuff about to be cast out, or else particles of food just taken in. It would be extremely interesting to study more closely the genus Protospongia (also the second Protospongia form described by Oxley, and consisting of numerous individuals), paying special attention to the phenomena of nutrition and propagation. Meanwhile we may accept the fact that this Choano-Flagellate possesses two forms of individual, which naturally can pass one into the other,—a flagellate and an amœboid form, the latter of which is able to migrate from various points of the surface into the common mass of jelly. Protospongia thus offers such an unmistakable likeness to certain two-layered sponge-larvæ (for instance, the larva of *Aplysina sulphurea* described by F. E. Schulze (33)), that we may suppose the differentiation of an amœboid form of individual to have been the first step in the historic development of the endoderm.

At any rate, I believe the peculiarities of Protospongia can be more easily harmonized with my view (called by some writers the Parenchymella theory) than with any of the above-discussed theories of other investigators. But how does the Parenchymella theory agree with the facts of embryology in general, and of the Medusæ, as given in the preceding part of the book, in particular? In discussing this question we must, in the first place, recall the *a priori* conclusion to which I came regarding the multiplication of the hypothetical Metazoo-Flagellata. Reasoning from the fact that the first three segmentation planes (sagittal, frontal, and equatorial) in so many and various groups of animals follow the three dimensions of space, and consequently represent transverse and longitudinal division, I concluded that the ancestors of the Metazoa also possessed these two kinds of division. Gradually, however, the direction of division became more fixed, so that while one form divided exclusively or predominantly in a longitudinal plane another related form divided transversely. That such a condition of affairs as we have here sketched is not impossible is shown by the life-history of the several species of Salpingœca already referred to. We must therefore suppose that in our colonies of Metazoo-Flagellata certain of the superficial cells became amœboid and migrated into the centre of the colony, as occurs to-day in Protospongia, and that certain other cells divided transversely into two segments, one of which retained its position at the surface, while the other came to lie within the central space. Figure 3 illustrates these processes in a diagrammatic fashion. This double method of forming the endoderm, by the immigration of some cells and the cutting off of the central segments of others, is actually employed in those species that have a mixed delamination. For instance, *Polyxenia leucostyla* (Fig. 4). In the next place, transverse division became predominant in some forms (Fig. 5) and longitudinal division in others, in which latter case the endoderm was formed by the immigration of superficial cells (Fig. 6). In this manner mixed delamination split up into primary delamination, on the one hand, and multipolar immigration, on the other. Secondary delamination is to be regarded as a mere modification of mixed delamination, from which it is distinguished by the late appearance of any difference between the ectoderm and endoderm cells.

It is necessary to assume that multipolar immigration is a more primitive form than unipolar immigration (Fig. 7), since the contrary supposition leads us into great difficulties, as we have already seen. The transition from a multipolar to a unipolar immigration (where the seat of migration is always the hinder



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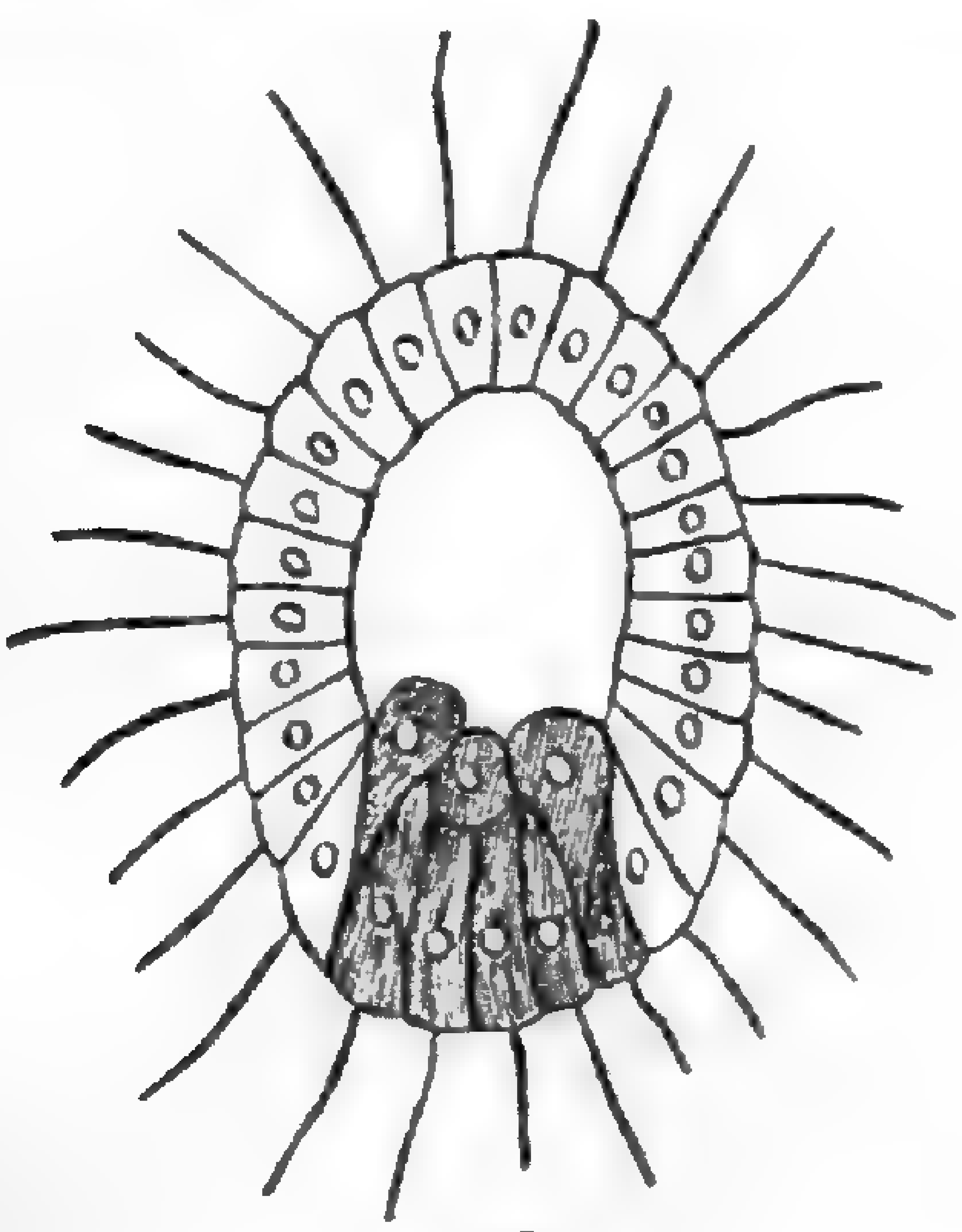
end of the larva) is, on the other hand, an easy conception, especially as the latter is prone to occur in blastula larvæ that are very active, while the former is observed in motionless or sluggish embryos. It is as well to recall here the great predominance in the metagenetic Medusæ of cell-immigration over transverse division.

If there be no difficulty in deriving unipolar from multipolar immigration, there is likewise none in reducing invagination to the former. We learned in the third chapter that *Laodice cruciata* is distinguished from other metagenetic Craspedota by the fact that the posterior pole of the blastula is occupied by a continuous area of transparent cells. These cells, however, do not immigrate all at once, but one after another as in other Medusæ (Fig. 8). There is then formed a parenchymatous endoderm, which gradually acquires a cavity, the endoderm becoming epitheliar. The stage with the area of transparent cells is strikingly like the blastula stage of *Nausithoë marginata,* Atlas, Plate X. (invaginate gastrula), in which the cells at the posterior pole likewise differ from the other cells of the body. Let us suppose the development of Laodice to be still further abbreviated. The endoderm cells, still at the surface but already differentiated, will no longer immigrate one at a time, but will invaginate in a body, and thus in a more direct way establish a gastric cavity (Fig. 9). The invagination of those cells that are the first to differentiate, once accomplished, the neighboring parts of the blastoderm are also involved in the process, and the invaginated sac gradually becomes larger. The next stage in the process of abbreviation is not to be observed in the Medusæ. We may conceive it to consist in the still earlier differentiation of the endoderm cells, as a result of which all the cells destined to invaginate are already marked out in the blastula as peculiar elements. The flattened blastospheres found in Lumbricus and



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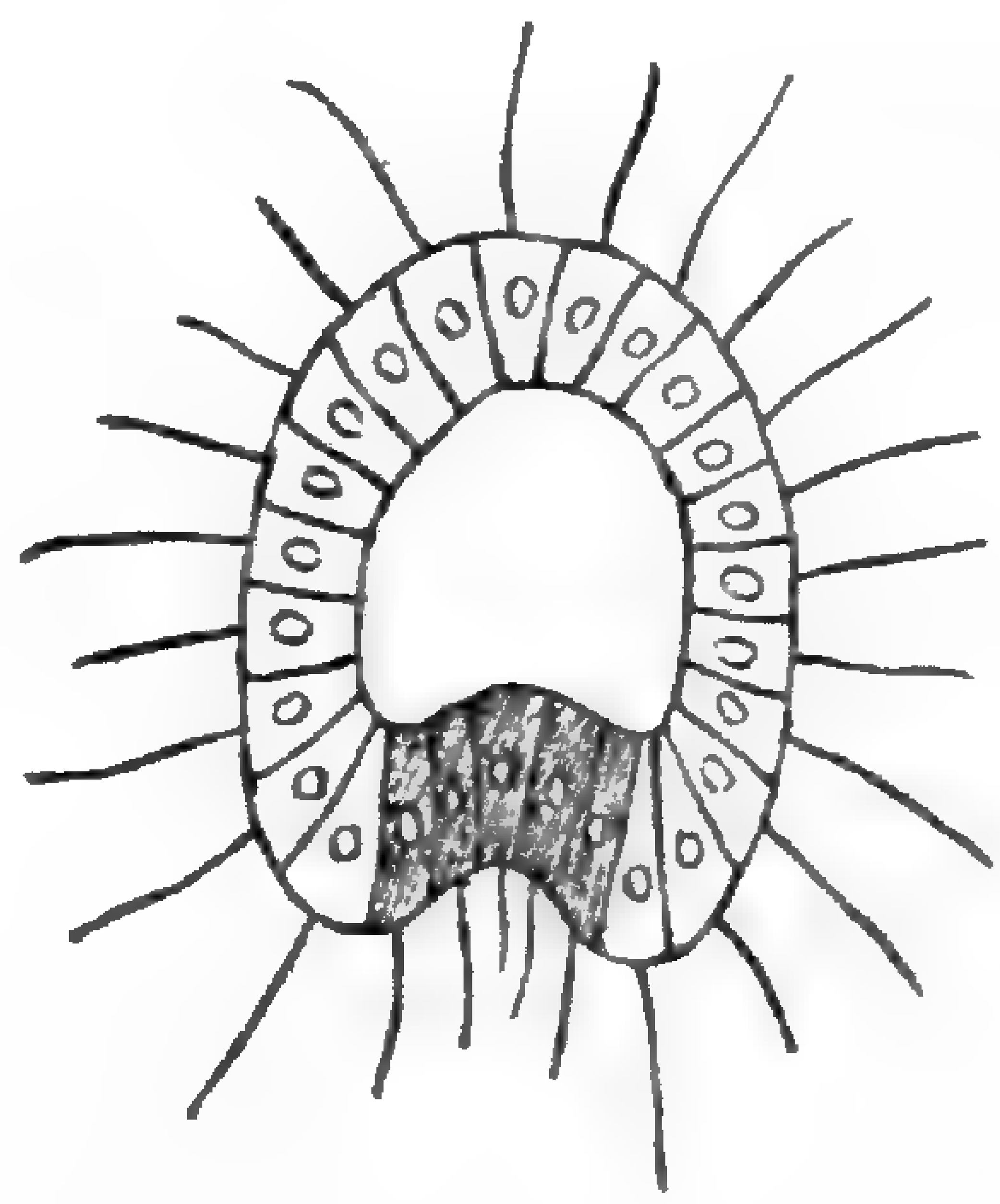

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the Ascidians, for instance, must be looked on as having been formed by some such abbreviation. In these blastospheres the ectoderm and endoderm areas are about equal. It needs no explanation to see that this early differentiation of the endoderm, carried far enough, will lead to the amphiblastula, will then make itself perceptible in the segmentation, and will finally be expressed in the structure of the egg itself.

It has been generally acknowledged since Kowalevsky's work on Euaxes that an amphigastrula (epibolic gastrula) may arise from an archigastrula by precocious differentiation. But it must also be admitted that a similar form (to the amphigastrula) may be derived from a mixed delamination by means of unequal segmentation. This latter view is supported by *Polyxenia leucostyla.* (The segmentation of this medusa is variable and in some eggs decidedly unequal, in which case the segmenting eggs strongly resemble epibolic gastrulæ.) It is thus evident that amphigastrulæ may come by two different ways from two different starting-points, and this embryonic form is hence polyphylitic.

From our point of view the endoderm must be regarded as an aggregate of cells, which were originally derived from the blastosphere by immigration or transverse division, and which then became associated together to form a mass of amœboid elements. The gastric cavity, as well as the mouth, must be regarded as later acquirements, whose appearance, however, in the ontogeny of certain forms has been so accelerated as to lead to the direct production of a gastrula.

Balfour (29), who has declared against the parenchymella theory, admits "that it fits in very well with the ontogeny of the lower Hydrozoa." Now that our knowledge of the facts is much greater than it was when this quotation was written, the harmony is still more marked. Balfour says in the same place (vol. ii. p. 285) that the passage from the protozoan to the metazoan state postulated by this theory strikes him as "very improbable in itself." But I cannot answer this criticism, since the assertion is made without any attempt to support it by argument. Much more precise are Bütschli's objections, which, however, concern the physiological side of the question exclusively. After a short account of my views, he remarks as follows (l. c., p. 418): "It seems to me that the endoderm cells, whose special business it is to take in food, would lose rather than gain by migrating into the interior of the colony. Without the simultaneous formation of a mouth, for which neither this nor Lankester's hypothesis can offer any reason, the immigration of the endoderm cells would be a decided disadvantage, since they then, so to speak, lock themselves in." When I first described my theory of the formation of endoderm by immigration (8), I referred to Volvox, in which the reproductive individuals leave the surface of the colony for the central cavity. At the present time I can also refer to the immigration of individuals that takes place in Protospongia, and which is certainly not without advantage to the colony in general. There are, moreover, *a priori* considerations to be taken into account. The individuals of a colony of Flagellata must first have become dissimilar, and this dissimilarity must then have given rise to a further differentiation. While some individuals were especially enabled to take in food, others were altered with reference to the locomotion of the colony and the attraction of food-particles. In motile colonies it must be of the greatest advantage for the heaviest individuals, and consequently those laden with food, to move as near as possible to the centre. Another advantage would be gained if the nutritive persons were enabled to pursue their calling under the best possible circumstances. Now we know that many Flagellata pass from a monad into an amœboid stage, and it is especially in the latter that they feed. I will quote Bütschli's account (23): "In a large number of monads food is only taken in at a particular spot, which is almost always at the base of the flagellum. There is no doubt of this fact, and it is equally true, on the other hand, that certain of these forms, which have been observed to pass occasionally into the amœboid condition, are, during this condition, able to take in food at other points of the body." It is easily conceivable also that the nutritive individuals should multiply more rapidly than the others, and a connection might thus be established between an unusually large food-supply and multiplication. Still another cause for the occurrence of immigration is found when we consider that a colony could not increase its superficial area beyond certain limits. This fact must have exerted great influence on swimming colonies especially. Since increase in the number of individuals in our colony was sure to lead to increased activity, it was manifestly advantageous that cells, for which no room could be found at the surface, should adapt themselves to a life in the interior. The difference between individuals of the same stock was probably for a long time a mere quantitative difference: the locomotor cells attracted particles of food by means of the currents set up by their flagella, and also took in some of the smaller particles, as in certain Cœlenterates to-day, where the ectoderm cells occasionally take in bits of food (9). The amœboid individuals inside were, on the other hand, able to devour larger bodies, which the locomotor cells could not master. When thus engaged, the amœboid cells were very probably near the periphery, and no doubt made use of the numerous pores penetrating the superficial layer in order to get at the bits of food lying on the surface. For analogies to such a performance I may refer to the fact that in *Halisarca pontica*, under certain circumstances (8), foreign bodies are devoured by amœboid cells, and that in many of the lower animals the same is done by mesoderm cells. The differentiation gradually made greater progress in the path thus marked out. The locomotor cells lost more or less completely the nutritive function, which became concentrated in the amœboid phagocytes. The very fine pores between the outer cells became larger, and formed mouth-openings similar to those so richly scattered over the surface of a sponge. As the colony more and more took upon itself the character of an individual (of the second order), the superficial persons (of the first order) became differentiated into an ectoderm or kynoblast, while the internal amœboid persons united to form a phagocystoblast (parenchyma or meso-endoderm). When the cells of the latter, acting independently, were not able to master unusually large particles of food, they formed a plasmodium, such as is often observed around large foreign bodies in the endoderm of Siphonophores or in the mesoderm of many animals. The metazoon, now provided with two primitive organs, steadily increased its activity, and in consequence the need of an abundant food-supply was likewise increased, so that it became necessary to prey upon vegetable and animal organisms of considerable size. To do this some entrance larger than that afforded by the pores was required, and one or more unusually wide openings arose, which ultimately led to the formation of a mouth.

The differentiation of originally uniform individuals into locomotor individuals and phagocytes finds many analogies in existing animals. In the lower Cœlenterates, such as Hydro-polyps, actinias, certain Medusæ (Oceania, Phialidium, Cunina), the entire endodermal lining of the gastrovascular system is able to feed upon bodies in the intracellular fashion. In consequence of this each endoderm cell is at once a phagocyte and a locomotor individual, in those cases at least where the endoderm cells are flagellate. In other Cœlenterates, for instance, in Aglaura among the Craspedota, in Siphonophores, and Ctenophores, the endoderm is differentiated into amœboid epithelium cells, which alone take in food-particles, and into flagellate epithelium cells, whose business it is to keep the current going, but which cannot take in foreign bodies. In the Sponges we find similar phenomena. In many representatives of this class the flagellate endoderm cells act also as phagocytes, while in some silicious sponges this latter rôle is exclusively in the hands of amœboid cells, the flagellate epithelium serving only to keep up the current of water.

It is evident enough that the migration of some individuals from the surface into the interior, which was probably filled with jelly, does not exclude the occurrence of transverse division in other individuals. It is also evident that the superficial portion of a cell which has thus divided might, when differentiation began, retain its original position, while the central portion lived on in the interior as a phagocyte.

The transitional form between the Metazoa and Flagellata has been called by me in a previous publication Parenchymella. I would like now to change the name to Phagocytella, for the reason that the latter suggests a very characteristic peculiarity of the form in question. The Phagocytella, as we have already learned, was characterized by the possession of two primitive organs, a kynoblast and a phagocytoblast, which were not as yet so sharply separated from each other as are the germinal layers of most Metazoa. Very probably the phagocytoblast continued for a long time to receive recruits from the kynoblast, in the shape of immigrating cells. As regards the development of Phagocytella we feel safe in supposing that the eggs (sexual multiplication must already have been acquired) underwent an equal segmentation, in which the divisions of the blastomeres followed the three dimensions of space; and that a blastocœl appeared very early, which was gradually filled up by immigrant cells and by the central portions of other cells that had suffered transverse division.

The Phagocytella theory is in harmony with our morphological and physiological knowledge of the Sponges. Indeed, it was in the study of this group that the theory had its origin. The embryology of the Sponges exhibits almost more variety than does the development of the Medusæ; at least, although far from being sufficiently studied, it reveals the several processes of immigration, delamination, and invagination. In general, then, what has been said for the Medusæ will describe the various ways in which the endoderm is formed among the Sponges. The primitive organs of the latter group, however, have progressed relatively but a short distance from their original state; it is for this reason that it is difficult to homologize the layers of a sponge with the germinal layers of other Metazoa. The "endoderm" often shades into the "mesoderm," the two structures being in the most intimate connection (8); I therefore think they must be regarded as together forming a phagocytoblast. This conception is not in the least weakened by the fact that the cells forming these layers do not appear all at once, but often gradually migrate from the ectoderm (for instance, in Halisarca). The organization of the Sponges presents no peculiarities such as to justify us, along with Balfour and Bütschli, in separating the group from the other Metazoa. In this respect, therefore, I fully agree with most students of the Sponges, more especially with K. Heider (30). The lack of a mouth-opening, or in other words, the presence of numerous pores of entrance, can only be accounted as an important distinction, when an unwarranted genealogical significance is ascribed to these structures. From the stand-point occupied by the Phagocytella theory, these peculiarities of the sponge body are easily explicable. Again, the predominant part played by the amœboid cells in taking in food would only give cause for surprise in case it were possible to speak of a differentiated mesoderm in the Sponges. But in this group there still endures a phagocytoblast, which must be regarded as the common foundation of endoderm and mesoderm; and consequently the rôle of the amœboid cells presents no difficulties.

About a year after I had given in my "Studies on the Sponges"[1] a general sketch of my views, Balfour arrived at conclusions regarding the phylogeny of the Cœlenterates which were in perfect accord with the principles of the Phagocytella theory. "Paradoxical as it may seem," says the English embryologist (29) (p. 147, vol. i.), "it appears to me not impossible that the Cœlenterata may have had an ancestor in which a digestive tract was physiologically replaced by a solid mass of amœboid cells. This ancestor was perhaps common to the Turbellarians also." It is very surprising that Balfour, believing this, was so strongly in favor of the gastræa theory, and regarded the parenchymella theory as improbable in itself. More recently Götte (34) has

[1] As early as 1877, in a paper on the digestive organs of fresh-water Turbellaria ("Memoirs of the Natural History Society of New Russia," vol. v.), I wrote as follows: "If the Turbellaria are actually parenchymatous animals, it is evident that in this respect there is a fundamental similarity between the lower representatives of two types of the Metazoa (Cœlenterata and Vermes); that is, between Sponges and Turbellaria. If we compare the larvæ of the first group, particularly the Amorphina larvæ described by O. Schmidt, with the lower Turbellaria, we are at once impressed with the probability that these two classes are much more closely related than has hitherto been supposed."

published, without referring to Balfour or myself, a repetition of the view that a close relationship existed between the ancestors of the Cœlenterates and Turbellaria (Acœla), and that the endoderm in the primitive Metazoa was in the shape of a parenchyma. From this paper it may be inferred that the number of students, who feel themselves compelled to postulate a Phagocytella-like condition, is gradually increasing. The latest researches on the anatomy of the Acœla (by Kleinenberg, Pereyaslawzew, Yves, Delage, and myself) confirm the statement of Graff, that a mesoderm and nervous system are wanting in these Turbellaria. The fact also remains that the digestive organs of the Acœla have preserved a very primitive condition, though it has recently been asserted that these worms possess an unmistakable digestive cavity.

On the contrary, the true Acœla exhibit an endodermal plasmodium containing vacuoles of various sizes, which may imitate the appearance of a special digestive cavity. I was best able to make out these facts on a transparent pelagic form of great beauty, which I obtained at Messina (where it has been several times studied by Kleinenberg), and which fully convinced me of the truth of the statement just made. It appears from the embryological investigations of Miss Pereyaslawzew (35) and of Repiachoff (36), that in the Acœla studied by them the segmentation is followed by a gastrula stage. The latter author concludes from this fact that the Acœla are degenerated worms. But the formation of a gastrula is by no means to be unconditionally regarded as a genealogically primitive process. In the development of the Medusæ we saw that the gastrula (in one case as the archigastrula of Nausithoë and Pelagia, in the other as the epibolic gastrula of *Polyxenia leucostyla*) might arise polyphyletically from totally different methods of forming the endoderm. It is quite possible, then, to regard the occurrence of a gastrula in the course of development as a secondarily acquired embryonic adaptation. Finally, I must remark that not until the work of Miss Pereyaslawzew and of Repiachoff has been published in full should an ultimate decision regarding the gastrula of the Acœla be expressed.

Since my view supposes that gastrula forms may arise independently in the course of embryonic development, on its adoption many difficulties encountered by the gastræa theory are either solved or escaped. In this connection I refer to my "Studies in Comparative Embryology" (10), where I have discussed this side of the question. Blochmann (37) and Sedgwick (38) have recently endeavored to rescue the gastræa theory by once more propounding the view that the mouth and anus have both been formed from a slit-like blastopore. The evidence on which this view is based consists of Balfour's study of Peripatus, and of observations on Aplysia and other Gasteropods. The authors believe, however, that a slit-like blastopore which gives rise to both mouth and anus, may be assumed to occur in the Metazoa generally. But the gastræa theory is not thus freed of its main burden, for, if we accept this assumption, the radial gastrulæ of the Echinoderms, Pilidium, and Polygordius must be looked on as larval forms secondarily modified to a great degree, while the embryos of the Gasteropods, Peripatus, Insects, and Worms with a slit-like blastopore would represent the condition of the primitive gastrula. In like manner the regular blastospheres of the former animals would have to be regarded as the modified descendants of the amphiblastulæ, rich in yelk, of the latter.

The genealogy of the anus, which is not satisfactorily elucidated by the theory just discussed, is to be traced in a series of stages such as we have assumed to occur in the development of the mouth. In the lower Metazoa we observe two (Ctenophora) or more openings for the exit of the excreta, just as in the Sponges there are numerous openings for the entrance of food. In some of the Medusæ belonging to the family Lafœidæ (Æquorea, Tima) the numerous excretory openings of the gastro-vascular system are seated on special papillæ; some of the Polycladæ possess similar excretory openings on various parts of the body. In Cycloporus (39) Lang observed the extrusion of some drops of fluid containing differently-colored concretions through such external openings of the digestive apparatus. This observation is all the more significant because the Polycladæ possess, besides these openings, a special excretory system.

While one portion of the phagocytoblast developed into the endoderm, in which the originally amœboid cells gradually assumed an epithelial character, another portion of the same primitive organ gave rise to the mesoderm. The latter originally appeared in the shape of solitary migratory cells, which continued as before to function as phagocytes. This condition is found in many Cœlenterates (where, however, in certain cases, additional cells migrate from the ectoderm, as in Corals, according to Kowalevsky and Marion), in Echinoderms, many Worms, etc. In some forms the whole mesoderm, in others only a part, permanently retained the original phagocytoblast condition. With many of the latter it came to pass that the mesoderm was formed by means of special sacs, which were constricted off from the endoderm. The cells of which these sacs were built ceased more or less completely to play the part of phagocytes. Such a condition appears in the Ambulacraria and in Vertebrates. In other animals with a simpler development,—for instance, Worms, Molluscs, and many Arthropods,—such mesoderm sacs have been looked for in vain; so that in these animals it is possible that the entire mesoderm has been derived from the original phagocytoblast without the aid of special endodermal sacs, though probably with some help from the ectoderm. In such cases the mesoderm has been able gradually to differentiate itself into a somatopleure and a splanchnopleure, without running through a sac-like stage. In Arthropods with a large amount of food-yelk the mesoderm is functional at a very early date, it being the habit of the mesoderm cells to devour the yelk-globules. Under such circumstances it can be understood how the mesoderm, even within the most recent time, has often been taken for the endoderm. In its origin dependent on the phagocytoblast, in part also on the kynoblast, the mesoderm sooner (Ctenophora) or later acquires its freedom and appears as a special germ-layer, which plays an important part in the development of the embryo. In opposition to the authors who think the mesoderm had its origin in sexual organs or muscles, I believe it was originally a part of the phagocytoblast, and as such took part in the inception or absorption of food. The importance of the mesodermal phagocytes in physiological and pathological processes, as well as the morphology of the mesoderm, have been discussed by me in other papers (7, 9, 10, 11, 12, 13), to which I may refer, and thus avoid repetition.

In conclusion, I wish to say that not until we are enlightened to the utmost as regards the primitive condition of the Metazoa will it be possible to place comparative morphology on a safe basis. But so long as the question of the germinal layers is investigated in the anti-genealogical manner, all questions of greater importance will present the most invincible difficulties. For this reason I think that, in the absence of actual knowledge, hypotheses dealing with the early history of the germ-layers are not wholly unjustifiable.

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HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 333.)

THE BEET. *Beta vulgaris, var. γ* L.

THE beet is essentially a modern vegetable. It is not noted by either Aristotle[2] or Theophrastus,[3] and although the root of the chard is referred to by Dioscorides and Galen,[4] yet the context indicates medicinal use. Neither Columella, Pliny, nor Palladius mention its culture, but Apicius,[5] in the third century, gives receipts for cooking the root of the Beta, and Athenæus,[6] in the second or third century, quotes Diphilus Siccineus as saying that the beet root was grateful to the taste and a better food than the cabbage. It is not mentioned by Albertus Magnus[7] in the thirteenth century, but the word *bete* occurs in English recipes for cooking in 1390.

Barbarus,[8] who died in 1493, speaks of the beet as having a

[1] Director of the New York Agricultural Experiment Station, Geneva.
[2] Aristotle, Scaliger's ed., 1566, 29.
[3] Theophrastus, Bodæus's ed., 1644, 778.
[4] Ex Fuchsius, De Stirp., 1542, 807.
[5] Apicius, lib. iii. c. 2, ii.
[6] Turre, Dryadum, etc., 1685, 443.
[7] Albertus Magnus, De Veg., Jessen's ed., 1867.
[8] Barbarus in Ruellius's Dioscorides, 1529, 124.

single, long, straight, fleshy, sweet root, grateful when eaten, and Ruellius,[1] in France, appropriates the same description in 1536, as does also Fuchsius[2] in 1542; and the latter figures the root as described by Barbarus, having several branches and small fibres. In 1558, Matthiolus[3] says the white and black chards are common in Italian gardens, but that in Germany they have a red beet with a swollen turnip-like root which is eaten. In 1570, Pena and Lobel[4] speak of the same, but apparently as then rare, and in 1576, Lobel[5] figures this beet, and this figure shows the first indication of an improved form, the root portion being swollen in excess over the portion by the collar. This beet may be considered the prototype of the long red varieties. In 1586, Camerarius[6] figures a shorter and thicker form, the prototype of our half-long blood beets. This same type is figured by Dalechampius[7] in 1587, and also a new type, the *Beta Romana*, which is said in Lyte's "Dodoens," 1586,[8] to be a recent acquisition. It may be considered as the prototype of our turnip or globular beets.

Red Beets.

I.

Beta rubra. Lob., 1576, 124; ic., 1591, i. 248; Matth., 1598, 371.

B. rubra Romana. Dod. 1616, 620.

Common Long Red. Mawe, 1778.

Betterave rouge grosse. Vilm., 1883, 38.

Long Blood. Thorb., 1828, 1886.

II.

Beta rubra. Cam. Epit., 1586, 256; Lugd., 1587, 533; Pancov., 1673, n. 607.

Betiola rossa. Cast. Dur., 1617, 71.

Betterave rouge naine. Vilm., 1883, 37.

Pineapple beet.

III.

Beta erythorrhizos Dodo., Lugd., 1587, 533.

[1] Ruellius, De Natura Stirpium, 1536, 481.

[2] Fuchsius, l. c.

[3] Matthiolus, Comment., 1558, 249.

[4] Pena and Lobel, Adv., 1570, 93.

[5] Lobel, Obs., 1576, 124.

[6] Camerarius, Epitome, 1586, 255.

[7] Hist. Gen. Lugd., 1587, 532.

[8] Lyte's Dodoens, 1586, 634.

Beta rubra radice crassa, alia species. J. Bauh., 1651, ii. 961.
B. rubra . . . russa; Beta-rapa. Chabr., 1677, 303.
Turnip-pointed red. Mawe, 1778.
Turnip-rooted red. Bryant, 1783, 26.
Early Blood Turnip. Thorb., 1828, 1886.
Arabic, *bangar.* Delile.

Yellow Beets.

I.

Beta quarta radice buxea. Cæsalp., 1603, ex Mill. Dict., 1807.
Yellow-rooted. Mill. Dict., 1807.
Betterave jaune grosse. Vilm., 1883, 41.

II.

Beta rubra, lutea; Beta-rapa. Chabr., 1677, 305.
Turnip-pointed yellow. Mawe, 1778.
Yellow Turnip. Thorb., 1828.
Betterave jaune ronde sucre. Vilm., 1883, 41.

One form we have omitted,—the flat-bottomed reds,—of which the Egyptian and the Bassano of Vilmorin, as figured, may be taken as the type. The Bassano was to be found in all the markets of Italy in 1841,[1] and the Egyptian was a new sort about Boston in 1869.[2] I have ascertained nothing concerning the history of this type.

The first step in improvement gained from the chard beets was a smoothening of the root, and the contrasts are to be seen in the figures given by the herbalists, commencing with Fuchsius. That this improvement was not continuous, but was contemporaneous with the less improved forms, may be seen by contrasting the figure of *Beta nigra,* given by Delachamp in 1587, and that given in Blackwell's "Herbal" in 1758, in which the roots are figured practically as of like form. Cultivation and selection have given greater size, greater thickness, smoothness of form, and other changes characterized by the term quality, but the type changes appeared at once as attention was directed to the value of the root.

The first appearance of the improved beet is recorded in Germany about 1558 and in England about 1576, but the name

[1] Gard. Chron., 1841, 183. [2] Trans. Mass. Hort. Soc., 1869, 70.

used, *Roman beet*, implies introduction from Italy, where the half-long type was known in 1584 certainly. We may believe Ruellius's reference in 1536 to be for France. In 1631 it was in French gardens under the name of *Beta rubra pastinaca*,[1] and the culture of "betteraves" was described in "Le Jardinier Solitaire," 1612. Gerarde[2] mentions the *Romaine beete*, but gives no figure, in 1597, and Bodæus a Stapel apparently knew only this kind in Holland in 1644. In 1665, in England, only the *Red Roman* was named by Lovell,[3] and the *Red Beet* was the only kind noticed by Townsend,[4] a seedsman, in 1726, and a second sort, the common long red, is mentioned in addition by Mawe[5] in 1778, and by Bryant[6] in 1783. In America one kind only was in McMahon's[7] catalogue of 1806,—the red beet,—but in 1828 four kinds are offered for sale by Thorburn.[8] At present, Vilmorin[9] describes seventeen varieties and names and partly describes many others.

The modern names of the beet are,—in France, *betteraves potageres;* in England, *Garden Beet;* in Germany, *Salat-rube, Beete, Rothe rube;* in Spain, *remolacha hortelana*.[10]

BENINCASA. *Benincasa hispida* Cogn.

This cucurbit has been lately introduced into European gardens, but it has been grown in Eastern Asia for a long period. According to Bretschneider,[11] it can be identified in a Chinese book of the fifth century, and is mentioned as cultivated in Chinese writings of the seventeenth and eighteenth centuries. In 1503–8, Ludovico di Varthema[12] describes it in India under the name of *comolanga*. In 1859, Naudin[13] says it is much esteemed in Southeastern Asia, and particularly in China, and that the size of its fruit, its excellent keeping qualities, the excellence of its flesh, and the ease of its culture should long since have brought it into our garden culture. He had seen two varieties,—one, the cylindrical, ten to sixteen inches long, and one specimen twenty-

[1] Laurembergius, Hort., 1631, 191.
[2] Gerarde, Herbal, 1597, 251.
[3] Lovell, Herbal, 1665, 40.
[4] Townsend, Seedsman, 1726, 22.
[5] Mawe, Gard., 1778.
[6] Bryant, Fl. Diet., 1783, 26.
[7] McMahon, Am. Gard. Kal., 1806.
[8] Thorburn's Cat., 1828.
[9] Vilmorin, Les Pl. Pot., 1883, 35.
[10] Vilmorin, l. c.
[11] Bretschneider, Bot. Sin., 59, 78, 83, 85.
[12] Travels of Ludovico di Varthema, 1503–8. Hak. Soc. Ed., 161.
[13] Naudin, Revue des Cucurbitaceæ. Ann. des Sc. Nat., 4th ser., t. 12, p. 10.

four inches long by eight to ten inches in diameter, from Algiers; the other an ovoid fruit, shorter, yet large, from China. The long variety, the seed from France, I grew in 1884, the fruit, oblong cylindrical, resembling very closely a watermelon while unripe, but when ripe covered with a heavy glaucous bloom.

This plant is recorded in herbariums as from the Philippine Islands, New Guinea, New Caledonia, Feegee Islands, Tahiti, New Holland, and Southern China; as cultivated in Japan and in China.[1]

In India the Benincasa is called the *Pumpkin*, and *White Gourd*[2] or *White Pumpkin*[3] in English, by the natives *chal koomra*,[2] *panee koomra*,[2] or *petha*;[4] in Japan, *ko* or *jungaoo*.[5] In France, *Benincasa* and *Courge a la cire*.[6]

This species is the *Cumbulam* of Rheede, Hort. Mal., 8, p. 5, t. 3; the *Camolenga* of Rumphius, Amb., 5, 395, t. 143; the *Cucurbita Pepo* of Louriero, Cochinch., 593; *Benincasa cerifera*, Savi., etc.

Blite. *Blitum* sp.

These spinage plants are almost of too little consequence for mention, yet they are included by Vilmorin[7] among garden vegetables. The blites are mentioned by Petit[8] as grown by amateurs in France on account of the singularity of their fruit, which resemble strawberries, and also by De Candolle[9] in 1815. Hence the English name *Strawberry blite*, and the French, *Epinards-fraises*. They are not mentioned by Noisette in 1829, nor do the seed occur in American seed lists. The plant that commentators interpret as the blite was cultivated by the ancients, but the descriptions appear to us to be too indefinite to enable identification.

Blitum capitatum L.

This species, if Linnæus's synonymy can be trusted, was known to Bauhin[10] in 1623, and by Ray[11] in 1686. Miller's "Gardeners' Dictionary" refers it to J. Bauhin,[12] who received the plant in 1651. The species was during this time little known outside of botani-

[1] Cogniaux, Cucurbitaceæ, De C. Monog., 1881, iii. 513.
[2] Firminger, Gard. in Ind., 126.
[3] Pickering, Ch. Hist., 606.
[4] Royle, Illust. of the Bot. of the Him., 218.
[5] Kaempfer, Amoen., 1712, 811.
[6] Vilmorin, Les Pl. Pot., p. 34, figured.
[7] Vilmorin, l. c., 1883, 207.
[8] Petit, Dict. du Jard., 1826, 40.
[9] De Candolle, Fl. Fran., 1815, iii. 382.
[10] Bauhin, Pin., 1623, 119, n. 7.
[11] Ray, Hist., i. 197, n. 5, 7.
[12] J. Bauhin, Hist., 1651, ii. 973.

cal gardens. The first mention of its garden culture that I find is by De Candolle,[1] in 1815, for France.

Blitum virgatum L.

This species was cultivated in France in 1815,[1] and also at Geneva and in Germany, but probably only in a slight degree. It is also grown in the vegetable gardens at the Mauritius.[2] Clusius[3] grew it in 1595. Ray[4] in 1686 had probably never seen it in England, for he copies Clusius.

BORAGE. *Borago officinalis* L.

This plant, of such little consequence in our gardens, yet finds place in our seed lists. Native of the Mediterranean countries, it was early cultivated for the use of the leaves and flowers in cooling drinks, in salad, and for garnishing. It occurs with blue, red, and white flowers, and also with variegated leaves, but the ordinary form is the blue flowered. Noisette[5] says it is more used in Italy than in France, but in France Quintyne,[6] the royal gardener in 1690, made several sowings during the summer for the supplying of its tender leaves. Ainslie[7] says it is cultivated by Europeans in India, and it was among the plants enumerated by Peter Martyr[8] as planted at Isabella Island by the companions of Columbus. It occurs in American seed lists from 1806 to the present date, and on account of its general use in England in Elizabeth's time probably came over with English colonists. The various colored flowering sorts of Borage are found noted or figured by nearly all the ancient herbalists.

Borage is called in France *bourrache officinale, b. batarde, fausse bourrache, langue-de-bœuf,* and *langue d'oie;* in Germany, *borretsch gurkenkraut;* in Flanders, *beruagie;* in Italy, *boragine, borrana;* in Spain, *borraja;* in Portugal, *borrajem;*[9] in Greece, *vouraza, armpeta,* and *arnopetra;* in Egypt, *lissan el tor., i.e.,* ox tongue,[10] as also in Arabic.[11]

BROCOLI. *Brassica oleracea botrytis, cymosa, Broccoli* De C.

The differences between the most highly improved varieties

[1] De Candolle, Fl. Franc., l. c.
[2] Bojer, Hort. Maur., 270.
[3] Clusius, Hist., 1601.
[4] Ray, l. c., n. 6.
[5] Noisette, Man., 1829, 337.
[6] Quintyne, Comp. Gard., 1704 ed., 182.
[7] Ainslie, Mat. Med., ii. 145.
[8] Eden's Hist. of Trav., 1577, 18.
[9] Vilmorin, Les Pl. Pot., 1883, 54.
[10] Pickering, Chron. Hist., 263.
[11] Delile, Fl. Ægypt, illust.

of the Brocoli and the Cauliflower are very slight; in the less changed form they become great. Hence two races can be defined, the sprouting brocolis and the cauliflower brocolis. The growth of the Brocoli is far more prolonged than that of the cauliflower, and in the European countries it is grown as a hyemial plant, bearing its heads in the year following that in which it is sown. It is this circumstance that leads us to suspect that the Romans knew the plant and described it under the name of *cyma*. "Cyma a prima sectione præstat proximo vere," "Ex omnibus brassicæ generibus suavissima est cyma," says Pliny.[1] He also uses the word *cyma* for the seedstalk which rises from the heading cabbage. These excerpts indicate the sprouting brocoli, and the same additional use of the word *cyma* then as exists in Italy now with the word *brocoli*, which, for a secondary meaning, is used for the tender shoots which at the close of winter are emitted by various kinds of cabbages and turnips preparing to flower.[2]

It is certainly very curious that the early botanists did not describe or figure the brocoli. The omission is only explainable under the supposition that it was confounded with the cauliflower, just as Linnæus brought the cauliflower and the brocoli into one botanical variety. The first notice of the *brocoli* that I find is quoted from Miller's Dictionary, edition of 1724, in which he says it was a stranger in England until within these five years, and was called sprout colli-flower, or Italian Asparagus.[3] In 1729, Switzer[4] says there are then several kinds that he has had growing in his garden near London these two years, viz.: "that with small, whitish yellow flowers like the cauliflower; others like the common sprouts and flowers of a colewort; a third with purple flowers; all of which come mixed together, none of them being as yet (at least that I know of) ever sav'd separate." In 1778, Mawe[5] names the Early Purple, Late Purple, White or Cauliflower-brocoli, and the Black. In 1806, McMahon[6] mentions the Roman or purple, the Neapolitan or white, the green, and the black. In 1821, Thorburn[7] names the Cape, the White, and the Purple, and in 1828, in his seed list, mentions the Early

[1] Pliny, lib. xix. c. 41; lib. xx. c. 35. [2] Vilmorin, The Veg. Gard., 1885, 95.

[3] Miller's Dict., 1807, preface, p. 1.

[4] Switzer, A Comp. Method for Raising Italian Brocoli, etc., 1729, 2.

[5] Mawe, Gard., 1778. [6] McMahon, Am. Gard. Kal., 1806.

[7] Thorburn's Calendar, 1821.

White, Early Purple, the Large Purple Cape, and the White Cape or Cauliflower-brocoli.

The first and third kind of Switzer, 1729, are doubtless the heading brocoli, while the second is as probably the sprouting form. These came from Italy, and as the seed came mixed, we may assume that variety distinctions had not as yet become recognized, and that hence all the types of the brocoli now grown have originated from Italy. It is interesting to note, however, that at the Cirencester Agricultural College, about 1860, sorts of brocoli were produced, with other variables, from the seed of the wild cabbage.[1]

"The Sprouting or Asparagus Brocoli represents the first form exhibited by the new vegetable when it ceased to be the earliest cabbage, and was grown with an especial view to its shoots; after this, by continued selection and successive improvements, varieties were obtained which produced a compact white head, and some of these varieties were still further improved into kinds which are sufficiently early to commence and complete their entire growth in the course of the same year; these last named kinds are now known by the name of Cauliflowers."—*Vilmorin.*[2]

The names of the Brocoli are,—France, *chaux brocolis*, *Chou-fleur d'hiver;* Germany, *broccoli*, *brockoli*, *spargelkohl;* Flanders and Holland, *brokelie;* Denmark, *broccoli*, *asparages kaal;* Italy *cavol broccolo;* Spain, *broculi;*[3] Arabic, *sjami;*[4] India, *chootee phool kobee.*[5]

BRUSSELS SPROUTS. *Brassica oleracea, bullata, gemmifera* De C.

This vegetable, in this country only grown in the gardens of amateurs, yet deserving of more esteem, has for a type-form a cabbage with an elongated stalk, and bearing groups of leaf-buds in the axils of the leaves. Sometimes occurring as a monstrosity, branches instead of heads are so developed, as I noted in 1883. Quite frequently an early cabbage, after the true head is removed, will develop small cabbages in the leaf-axils, and thus is formed the *Brassica capitata polycephalos* of Dalechamp,[6] 1587, which he himself describes as a certain unused and rare kind.

Authors[7] have stated that the Brussels Sprouts has been

[1] Agr. Gazette, Sept. 8, 1879, 217.
[2] Vilmorin, The Veg. Gard., 1885, 95.
[3] Vilmorin, Les Pl. Pot., 1883, 151.
[4] Forskal, Fl. Ægypt Arab., liv.
[5] Speede, Ind. Handb. of Gard., 118.
[6] Hist. Gen. Lugd., 1587, 521.
[7] Booth, Treas. of Bot., etc.

grown from time immemorial about Brussels, in Belgium, but, if this be so, it is strange that they escaped the notice of the early botanists, who would have certainly noticed a common plant of such striking appearance and have given a figure. Bauhin,[1] indeed, in 1623 gives the name *Bras. ex capitibus pluribus conglobata*, and adds that some plants bear fifty heads the size of an egg, but his reference to Dalechampius as a synonyme would lead us to infer that the plant known to him was of the same character as that figured by Dalechampius, above noted. Lobel[2] again in 1655 refers to a cabbage like a *Brassica polycephalos*, but as he had not seen it he says he will affirm nothing. Ray[3] again in 1686 refers to a like cabbage.

A. P. Decandolle[4] in 1821 describes the Brussels Sprouts as commonly cultivated in Belgium, and implies its general use in French gardens, but Booth[5] says it is only since about 1854 that it has been generally known in England. A correspondent[6] of the *Gardeners' Chronicle* in 1850, however, refers to the *Tall* sorts as generally preferred over the *Dwarf* by the market gardeners about London. In American gardens it is mentioned in 1806,[7] and this implies its general use in Europe.

But two classes are known, the Tall and the Dwarf, and but a few minor variations in these classes. The tall is quite distinct in habit and leaf from the dwarf, the former having less crowded "sprouts" and a more open character of plant, with leaves scarcely blistered or puckered. As, however, there is considerable variation to be noted in seedlings, furnishing connecting links, the two forms may legitimately be considered as one, the differences being no greater than would be explained by the observed power of selection and of the influences for modification which might arise from the influence of cabbage pollen. This fact of their being but of one type, even if with several variables, would seem to indicate a probability that the origin is to be sought for in a sport, and that our present forms have been derived from the propagation of and selections from the seedlings derived from a suddenly observed variable of the Savoy cabbage type, and, as the lack of early mention and the recent nature of

[1] Bauhin, Pinax, 1623, iii. [2] Lobel, Stirp. Illust., 1655, 82.

[3] Ray, Hist., 1686, 794.

[4] Mem. upon the Cult. Brassica. Hort. Soc. Trans., p. 14.

[5] Booth, Treas. of Bot. [6] Gard. Chron., 1850, 116.

[7] McMahon, Am. Gard. Kal., 1806, 580.

modern mention presupposes, some time scarcely preceding the last century.

The names given in various languages to the Brussels Sprouts are as follows: France, *chou de Bruxelles, ch. rosette, ch. a jets, ch. a jets et rejets, ch. spruyt de Bruxelles;* Germany, *rosenkohl, sprossenkohl;* Flanders and Holland, *spruitkool;* Denmark, *rosenkaal;* Italy, *cavolo a germoglio;* Spain, *bretones de Brusselas;* Portugal, *couve de Bruxelas d'olhos repolhudos.*[1]

Buckshorn Plantain. *Plantago Coronopus* L.

A salad plant of very minor importance. It is mentioned as grown in gardens by Camerarius, 1586,[2] and by very many of the other botanists of the sixteenth and seventeenth centuries; is described by Ray[3] in 1686 as cultivated in England, and not differing from the wild plant except in size and in the other accidents of culture. Townsend,[4] in 1726, says the seed is now "in all the Seedsmen's Bills, tho' it is seldom in the Gardens." It is described and figured by Vilmorin[5] among French vegetables. During the three hundred years in which we find it pictured, we find no evidence of any essential changes produced by cultivation.

The names in the European languages are,—English, *buckshorn plantain, star of the earth;* in France, *Corne-de-serf, courtine, pied-de-corbeau, pied-de-corneville;* in Germany, *hirschhorn salat;* in Flanders, *veversblad, hertshoorn;* in Italy, *corno di cervo, coronopo, erba stella;* in Spain, *estrellamar, cuerno de ciervo.* By the ancient botanists, *Coronopus, Cornu cervinum,* and *Herba stella.*

Bunias. *Bunias orientalis* L.

The young leaves and shoots are rather recommended by Vilmorin either as a salad or boiled. It is named by Tournefort *Crambe orientalis, dentis leonis folio, erucaginis facie.* Vilmorin gives its native country as Western Asia. I do not know of its appearance in American gardens.

It is called in England *Turkish Rocket;* in France, *Bunias d'Orient.*

Burdock. *Arctium lappa* L.

The use of the succulent stems of the Burdock as a spinage

[1] Vilmorin, Les Pl. Pot., 1883.
[2] Camerarius, Epit., 1586, 276.
[3] Ray, Hist., 1686, 879.
[4] Townsend, Seedsman, 1726, 18.
[5] Les Pl. Pot., 1883, 169.

is noted by many authors, as by Ray[1] in England in 1686, and Bryant[2] in 1783, as also by Gerarde[3] in 1633. Kalm,[4] before 1770, records the use of the tender shoots as a salad in the region about Lake Champlain, and Bretschneider[5] the use of the roots and tender leaves in China in the fourteenth century. It remains for Japan to cultivate it as a common vegetable. "This root," says Kizo Tamari,[6] a Japanese commissioner to the New Orleans Exposition, "comes third in general estimation among our vegetables. It grows in some districts a foot in circumference and three feet in length, is soft and delicious. It will take a year to get such roots, but generally they do not exceed one inch and a half in diameter." This is Japanese testimony; but Penhallow,[7] who spent a year or so in Northern Japan, says the roots are tasteless, hard, and fibrous. As grown at Geneva, N. Y., 1884, the testimony was not in favor of any desirable quality. It was introduced to Europe from Japan by Siebold,[8] and the seed was offered in his trade list of 1856.

In Japan it is called *gobo* and *uma busaki*;[9] in English, *Edible Gobo*; in France, *Bardane geante a tres grandes feuilles*; in Germany, *Japanische klettee*; in Italy, *lappola*.[10]

This long-cultivated plant presents no differences except in size from the neglected plant of our waysides and fence corners.

BURNET. *Poterium sanguisorba* L.

The young and tender leaves of the Burnet taste somewhat like a green cucumber, and are employed in salads. It is rarely cultivated in the gardens, but occurs in all our books on gardening. Three varieties are described by Burr,—the Smooth-leaved, the Hairy-leaved, and the Large-seeded. This latter he deems but a seminal variation and a sub-variety only. The following synonymy seems clear:

I.

Pimpinella sanguisorba minor lævis. Bauh., Phytopin., 1596, 282.

[1] Ray, Hist., 1686, 332.
[2] Bryant, Fl. Diet., 1783, 55.
[3] Gerarde, Herbal, 1633, 811.
[4] Kalm, Trav., 1770–71, iii. 21.
[5] Bretschneider, Bot. Sin., 51.
[6] Am. Hort., Sept. 1886, 9.
[7] Penhallow, Am. Nat., Feb. 1882, 120.
[8] Siebold, Gard. Chron., 1856, 300.
[9] Thunberg, Jap., 304.
[10] Vilmorin, Les Pl. Pot., 1823, 28; The Veg. Gard., 1885, 234.

Poterium sanguisorba, var. B. Lin., Sp., 1411.

Smooth-leaved. Burr, 1863, 319.

II.

Sanguisorba minor. Fuch., 1542, 790.

Pimpinella and Bipinelia. Ang. *Burnet*, Ad., 1570, 320; Lob. obs., 1576, 412; *ic.*, 1591, i. 718.

Small or Garden Pimpernell. Lyte's Dod., 1586, 152.

Pimpinella minor. Lugd., 1587, 1087.

Pimpinella sanguisorba minor hirsuta. Bauh., Phytopin., 1596, 282.

Pimpinella vulgaris sive minor. Ray, 1686, 401.

Poterium sanguisorba. Linn., Sp., 1411.

Hairy-leaved Burnet. Burr, 1863, 319.

The garden culture of Burnet is implied in Lyte's[1] name, 1586. Ray,[2] however, a hundred years later, does not mention culture. In 1693,[3] Quintyne grew it in the royal vegetable garden in France, and in 1726, Townsend[4] says it is "a good plant for Sallads," and Mawe,[5] in 1778, says it has long been cultivated as a salad plant; while Bryant,[6] in 1783, says it is so frequently cultivated in gardens that to describe it would be unnecessary. I find it recorded for American gardens in 1832, and it then was doubtless a long-known plant. It is now grown in the Mauritius.[7]

In France the Burnet is called *pimprenelle petite;* in Germany, *garten-pimpinelle;* in Flanders and Holland, *pimpernel;* in Italy, *pimpinella, selvastrello;* in Spain, *pimpinela;* in Portugal, *pimpinella.*

[1] Lyte's Dodoens, 1586, 152.
[2] Ray, Hist., 1686, 401.
[3] Quintyne, Comp. Gard., 1693.
[4] Townsend, Seedsman, 1726, 33.
[5] Mawe, Gard., 1778.
[6] Bryant, Fl. Diet., 1783, 107.
[7] Bojer, Hort. Maur., 1837, 127.

(To be continued.)

THE MESOZOIC AND CÆNOZOIC REALMS OF THE INTERIOR OF NORTH AMERICA.

BY E. D. COPE.*

IN the following pages all the sources of information on the subject in hand have been laid under contribution. Chief among these are the reports of the United States geological survey of the Territories under F. V. Hayden, the United States geological survey of the fortieth parallel under Clarence King, and the United States geological survey west of the one hundredth meridian under Captain G. M. Wheeler, United States Engineers. The association of the author with the first and last named of these surveys in the field, and the examination of large collections of vertebrate fossils made in the region reported on, furnish the opportunities in his possession.

The author does not recognize in the following pages a Quaternary division of geological time, but regards the present period as a continuation of the Cænozoic or Tertiary Realm, including all after the beginning of the glacial age under the name Plistocene.

MESOZOIC REALM.

This system is distinguished from the Palæozoic in North America, as to the Vertebrata, as follows:

Presence of Reptilia Dinosauria, Ichthyopterygia, Sauropterygia ? Pterosauria, Testudinata, and Lacertilia; presence of Mammalia. Absence of Tunicata Antiarcha, Agnatha Arrhina, and Diplorhina,[2] of Pisces Placoganoidei, of Batrachia Ganocephala ? Rhachitomi and Embolomeri,[3] and of Reptilia Theromorpha.[4]

From the Cænozoic system the Mesozoic differs in the presence of Reptilia Dinosauria, Sauropterygia, Ichthyopterygia; of Mammalia Marsupialia Multituberculata;[5] and in the absence of Pisces Actinopteri,[6] Nematognathi, and Plectospondyli; of Aves Insessores, and Mammalia Diplarthra[7] and Rodentia.

* Read before the American Committee of the International Geological Congress at its meeting at Albany, April 6, 1887. The writer, previous to the adoption of the report of the proceedings of the committee for the previous year,[1] objected to the adoption of the word "group," as proposed by the Congress of Berlin, for the division of geological formations of first rank, and proposed to substitute the word "realm" therefor; *e.g.*, the Archæan, Palæozoic, Mesozoic, and Cænozoic Realms.

The primary systems of the Mesozoic are four, viz.:
Postcretacic,
Cretacic,
Jurassic,
Triassic.

TRIASSIC SYSTEM.

The vertebrate fauna is characterized by the presence of Reptilia Belodontidæ[8] and Aëtosauridæ, and of Mammalia Dromatheriidæ;[9] also by the absence of Dinosauria Opisthocœla,[10] Orthopoda, Parasuchia,[11] and Eusuchia; of Batrachia Anura and Urodela; of Saurodont and of Physoclystous fishes.

The division of the Trias into Muschelkalk and Keuper, so well marked in Europe, is not distinguishable in North America, our beds presenting the faunal characters of the Keuper or upper Trias of that continent. They, however, present two divisions which are lithologically distinct in Nevada, to which Mr. King[12] has given the names Koipato for the lower and Star Peak to the upper. The latter is of marine origin, while the Trias of the Rocky Mountains and of the Atlantic slope is lacustrine. The Rocky Mountain Trias is exposed upturned along both the eastern and western slopes of north and south ranges, and the north and south slopes of east and west ranges. In Nevada it forms the mass of the Havalla, Pah Ute, and West Humboldt ranges. Its thickness is, according to King,—

	Feet.
Colorado, east flank of mountains	300 to 1200
Nevada, Koipato bed	4000 to 6000
Nevada, Star Peak bed	10,000

Triassic beds probably also occur in the Indian Territory.*

JURASSIC SYSTEM.

The vertebrate fauna is characterized as follows:

Present: Reptilia Dinosauria Opisthocœla, Orthopoda, Mesosuchia; Testudinata Clidosterna; Ichthyopterygia Sauranodontidæ;[40] Batrachia Anura;[13] Mammalia ?Bunotheria.[14] Absent: Pisces Actinochiri, Saurodontidæ; Percomorphi; Dinosauria Belodontidæ; Reptilia Choristodera;[15] Aves Odontornithes; Mammalia Placentialia Ungulata, Creodonta, and Tillodonta.

* Triassic formations have not yet been detected in Texas, those recently referred by Mr. Hill of the United States Geological Survey to that age being the Permian beds of the Red River. (See Amer. Jour. Sci. Arts, 1887, p. 302.)

The Jurassic bed constantly overlies the Triassic along the flanks of all the Rocky Mountain ranges, consisting of clays, shales, marls, and cherty limestones. In Colorado it has, according to King, a thickness of seventy-five to two hundred and fifty feet. It grows thicker westward, reaching seven hundred feet on the west flanks of the Sierra Madre, in New Mexico, and according to King,[16] consists in Nevada of—

	Feet.
Slates	4000
Limestone	1500 to 2000

The forms of vertebrates found apparently together at this horizon are represented in Europe by genera of different subdivisions of the Jurassic. Hence it has not been possible to refer the Rocky Mountain beds to any of the latter, and Marsh has therefore designated them as the *Atlantosaurus* beds.[81]

A series of deposits lies between the Triassic and Cretaceous formations in the Middle Atlantic States, which have been supposed from the palæobotany to be of Jurassic age by Tyson.[17] What division, if any, of the European series they represent has not yet been ascertained, but they are regarded by Mr. McGee as belonging at the summit of the system. He names them the Potomac formation in an unpublished memoir.[18]

CRETACIC SYSTEM.

Characteristics.—Presence of Saurodont[19] and Actinochirous fishes; of Reptilia Eusuchia, Testudinata Protostegidæ, Propleuridæ, and Adocidæ; of Aves Odontornithes.[20] Absence of Pisces Ginglymodi[21] and Halecomorphi; of Reptilia Choristdera, Dinosauria Opisthocœla.

This formation has great extent and thickness in North America, and it displays a number of divisions, which differ both lithologically and faunally. These are the

Fox Hills,
Pierre,
Niobrara,
Benton,
Dakota,
Comanche.

The Comanche has been recently named and described by Hill.[22] It consists principally of limestones of varying character which contain numerous marine invertebrata, which have been determined by White to represent a horizon of the Cretacic lower than the Dakota, and corresponding with some member of the Lower Cretacic of Europe. No vertebrates known. The formation is seen between the east and west Cross-Timbers of Texas, and the thickness is not given.

THE DAKOTA[23] has not yet produced vertebrate remains, but abounds in plants which have, according to Lesquereux,[24] the character of those of the Turonian or Lower Chalk of Europe, with an admixture of Miocene and recent types. Its beds consist of generally hard sandstone and conglomerate, and they occur almost everywhere along the flanks of the Rocky Mountain uplifts, forming distinct hog-backs. The thickness is from three to four hundred feet.

THE BENTON.—These beds consist of dark-colored clays, more or less shaly, and have a thickness of from two hundred to four hundred and fifty feet. They contain vertebrate fossils, mostly fishes in poor preservation. The only vertebrate type observed in it which gives it character is a crocodilian reptile, with flat articular vertebral faces, provisionally referred to the genus Hyposaurus.[25] The Benton formation is widely distributed, usually present where the Dakota occurs, and lying conformably on it, and from its soft material, forming valleys.

THE NIOBRARA.—Composed of harder and softer argillaceous limestones and chalky marls, varying from one hundred to two hundred feet in thickness.[29] The Niobrara is present with the Dakota and Benton on the flanks of the Rocky Mountains, but has also a wide extent east and southeast of them, forming a large part of The Plains, and other large tracts in Texas.[26] * It probably occurs in the valley of the Red River of the North. It is a deep-water formation, and is very rich in fossils, vertebrate and invertebrate. Characterized as follows:

Present: Pisces Isospondyli Saurodontidæ, and Actinochiri, Hemibranchi Dercetidæ;[27] Reptilia Sauropterygia with long necks; Pythonomorpha, except Mosasaurus; Testudinata Protostegidæ; Pterosauria Pteranodontidæ;[28] Aves Odontornithes. Absent: Reptilia Crocodilia Procœla; Pythonomorpha, Mosasaurus.

PIERRE.—Dark carbonaceous shales and clays, and dark-colored

* See page 469 this number AMERICAN NATURALIST.

marls, which lie conformably on the Niobrara beds both on the flanks of the Rocky Mountains and on the northern parts of the Plains. Thickness (King), two hundred and fifty to three hundred feet.[29] Represented in the East, according to Meek and Whitfield, by the lower green-sand marl of New Jersey, Delaware, etc. Invertebrate fossils very numerous; vertebrates less numerous in the interior basin, more so on the Atlantic slope. The predominant genera in the two regions are Mosasaurus and Elasmosaurus, the latter occurring also in the Niobrara. The distinctness of this horizon from the latter on grounds of vertebrate palæontology depends chiefly on the fauna of the Eastern beds. The distinctions are,—

Presence of Reptilia Crocodilia Procœla; Pythonomorpha Mosasaurus.[30] Absence of Pisces Isospondyli Actinochiri; Pterosauria Pteranodontidæ; Aves Odontornithes.

It remains to be seen whether these differences will remain under future investigation.

Fox Hills.—Formed of sandstones more or less argillaceous, varying in thickness from thirty feet (Cope), Montana, to fifteen hundred feet (King), Colorado, to three thousand to thirty-five hundred feet in Southwest Wyoming (King).[29] The vertebrate fauna in the West is sparse, but in New Jersey it is very full. It is characterized in Montana by

Presence of Pisces Holocephali[31]; Haplomi (Ischyrhiza); Reptilia Pythonomorpha and Sauropterygia with short neck (Uronautes);[31] Crocodilia Procœla.

In New Jersey it has the same characters, with the additions,—

Present: Pisces Percomorphi Berycidæ;[32] Reptilia Testudinata Adocidæ and Pleurodira. Absent: Pisces Isospondyli Actinochiri.

Mr. King has combined the Benton, Niobrara, and Pierre into a single division, which he called the Colorado.[29] On palæontological grounds there is as yet no more reason for uniting these without than with the Fox Hills group. If the Fox Hills is retained as distinct, the others should be also. However, future research may change the present aspect of the case.

Total thickness of the Cretacic of the West, about four thousand nine hundred feet.

POSTCRETACIC SYSTEM.

This name was proposed and afterwards abandoned by White[33] for the lacustrine formations which rest conformably on the upper beds of the Cretacic (Fox Hills), whose palæontology will not permit them to be ranged with the Cænozoic system. The Vertebrata are as follows:

Presence of Pisces Ginglymodi and Halecomorphi; Reptilia Choristodera; Mammalia Marsupialia Multituberculata. Absence of Pisces Isospondyli Saurodontidæ and Actinochiri; of Reptilia Sauropterygia and Pterosauria.

There are two well-marked epochs of the Postcretacic,—the Puerco and the Laramie.

LARAMIE.—Present:[34] Pisces Elasmobranchi Myledaphus; Reptilia Dinosauria Goniopoda and Orthopoda. Absent: Mammalia Placentialia.

This formation has an immense extent on the northern plains in the United States[35] and Canada;[36] along the eastern flank of the Rocky Mountains, and on the western flanks of the same in New Mexico, and along the Lower Rio Grande in Texas and Tamaulipas.[37] It consists of sandstones, marls, and lignite, whose base rests conformably on the Fox Hills beds of the Cretaceous, when the latter is present. Thickness:

	Feet.
East flank of Rocky Mountains, Colorado (King)[38]	1500
Southwestern Wyoming (King)	5000
Upper Missouri, Montana (Cope)[31]	500
Northwestern New Mexico (Baldwin and Cope)[39]	2000

A formation has been observed along the Belly River, in Saskatchewan, by the geological survey of the Dominion of Canada, which they call the Belly River.[80] It is overlaid by the Pierre, and would be placed in the system in accordance with this position between that formation and the Niobrara below it. But the flora and the fauna, vertebrate and invertebrate, are identical, or nearly so, with that of the Laramie. The explanation of this singular state of the evidence has not yet been reached.

PUERCO.[41]—Present: Mammalia Placentialia. Absent: Pisces Elasmobranchi; Reptilia Dinosauria Goniopoda and Orthopoda.

The fauna[42] of this horizon is well distinguished from that of the Laramie in the absence of the numerous Dinosauria of the latter, and the presence of numerous Placental Mammalia in the former. On these grounds I at first referred the formation to the Cænozoic series, but further reflection induced me to place it as now arranged. The reason is as follows: Although Placental Mammalia are not now known otherwise from Mesozoic beds, the other forms of the Puerco are especially Mesozoic in character. Such are the Choristodere Reptilia and the Multituberculate Marsupialia, neither of which occur above, while both occur below the Puerco, the Multituberculata down to the Trias inclusive. Then the Placentialia are entirely peculiar in the absence of the Diplarthra and of the Rodentia,[39] orders always found in the Cænozoic beds. Then the characters of the Condylarthra and Amblypoda and many of the Creodonta, which represent Tertiary types, are so peculiar that we are led to suspect that when the Cretacic Mammalia are fully known they cannot differ very widely from those of the Puerco.

But one area of this formation is definitely known; this is in Northwestern New Mexico and Southwestern Colorado. It consists of sandstones and soapy marls, and has a thickness of eight hundred and fifty feet.[39] It is immediately overlaid by the Wasatch Eocene, and rests on the Laramie.

TOTAL THICKNESS of the Mesozoic system (greatest):

	Feet.
Triassic	16,000
Jurassic	6,000
Cretacic	4,900
Postcretacic	5,850
	31,750

CÆNOZOIC REALM.

This Realm is distinguished from the Cretacic, as well as from the Mesozoic formations as a whole, in North America by the following peculiarities. In Vertebrata:

By the presence of Diplarthrous Mammalia.
" " of Rodent "
" " of Nematognath Fishes.
" " of Plectospondylous Fishes.
" " of Osteoglossid "
" " of Pharyngognath "
" absence of Multituberculate Marsupial Mammalia.
" " of Orthopod and Goniopod Dinosauria.
" " of Choristodere Reptilia.

The primary systems of the Cænozoic Realm are
Plistocene,
Pliocene,
Miocene,
Eocene.

Although open to conviction, I have not perceived the necessity for the term Oligocene for a supposed system between the Eocene and Miocene. In America the faunal distinction between the latter is so marked as to render a third name, for the present at least, unnecessary.

The characteristic features of the faunæ of these divisions are as follows:

EOCENE.—*Mammalia.* Presence of Tillodontia, Tæniodontia, Mesonychidæ, Amblypoda, Condylarthra, and Lophiodontidæ. Absence of Carnivora, Ruminantia,* Proboscidia, Leporidæ, Palæotheriidæ (and Anthropomorpha Europe). *Pisces.* Presence of Osteoglossidæ and Gonorhynchidæ.

MIOCENE.—*Mammalia.* Presence of Carnivora, of Rhinocerontidæ, Leporidæ, Ruminantia,* and of Edentata. Absence of Tillodonta, Tæniodonta, Amblypoda, and Condylarthra.

PLIOCENE.—Presence of extinct families of Mammalia: Castoroididæ, Glyptodontidæ, Megatheriidæ, and Eschatiidæ, and of extinct genera, as Holomeniscus and Hippotherium.

PLISTOCENE.—*Mammalia.* All families are recent and most of the genera; many species also recent.

EOCENE SYSTEM.

The Eocene formations of the interior of North America are as follows:[43]
Uinta,
Bridger,
Wind River,
Wasatch.

These formations are clearly successive in their relations. There are two others, contemporary with one or more of these, whose characters are due to physical causes. They are the
Amyzon beds,
Green River shales.

They differ from each other in the following faunal peculiarities:

* *I.e.*, quadritubercular Selenodont Artiodactyla.

WASATCH.[44]—*Mammalia.* Presence of Tæniodonta, Condylarthra, and Pantodonta. Absence of Tillodonta, Dinocerata, Palæosyops, Hyrachyus, Amynodon, Achænodon, Triplopus, and suilline and selenodont Artiodactyla.

This formation is characteristic of the region between the Rocky Mountains proper and the Wasatches, and has three principal areas. The most southern is in Northwestern New Mexico; the middle tract is in Southwestern Wyoming and Northeastern Utah; the third tract is in Northwestern Wyoming, on the Big Horn River.

	Feet.
Thickness in Northwestern New Mexico (Cope)	2500
Thickness in Southwestern Wyoming (Hayden)	1500
Thickness in Northwestern Wyoming (Wortman)	4000

WIND RIVER.[45]—*Mammalia.* Presence of Condylarthra, Tæniodonta, Pantodonta, Dinocerata, Palæosyops, and Hyrachyus.

This fauna indicates the transition between the Wasatch and Bridger, since types are here associated which are elsewhere peculiar to the two horizons named. Thus, of the above zoological divisions the following are exclusively Wasatch: Tæniodonta and Pantodonta. The remaining ones are Bridger, excepting the Condylarthra, which probably occurs in both Bridger and Wasatch.

This formation is known from one area, which is on the headwaters of the Wind River, near the middle of Western Wyoming. The formation is, according to Hayden, not less than five thousand feet in thickness.

Near the horizon of the Wind River beds must be placed the Green River Shales.[46] This formation intervenes between the Wasatch and Bridger beds in Southwestern Wyoming, and differs entirely from both in lithological and palæontological characters. It consists of more or less finely-laminated calcareous or calcareo-silicious shales, which have a depth of two thousand feet. The sedimentation has evidently been fine, indicating deep and still water. The Vertebrata obtained are almost exclusively fishes, two species of Crocodiles being the only exceptions. The fishes are clearly of Eocene character, and embrace some types (Gonorhynchidæ, Osteoglossidæ, and Chromdidæ) now restricted to the Southern Hemisphere faunæ.[48] Two of these types, together with two other genera of fishes, occur in the Bridger beds; and the two last named (Clastes and Pappichtlys) are also found in the Wasatch. A probable second locality of this formation is known in Eastern Utah, in the Wasatch Mountains. The formation is known as the Manti beds.[47]

BRIDGER.—*Mammalia.* Presence of Tillodonta, ? Condylarthra, and Dinocerata, Hyrachyus, Palæosyops, Amynodon, Triplopus, and Achænodon. Absence of Tæniodonta, Pantodonta, and selenodont Artiodactyla.

Two divisions of this formation are sustained by Scott. These have been named the Bridger and Washakie respectively by Hayden. The former is represented by a single area, which is west of Green River, in Southwestern Wyoming. The latter is also known from but one area, which is also in Southwestern Wyoming, but is east of Green River. These divisions differ in the species they contain, very few, according to Scott, being common to the two. Amynodon is the only genus which in the Bridger seems to be confined to the Washakie division; perhaps Triplopus has the same distribution.

Another tract of the Bridger formation is known from Western Colorado, but to which of the two above divisions it is referable is unknown.

The depth of the Bridger proper is, according to King, two thousand five hundred feet. I have given that of the Washakie as about twelve hundred feet.

UINTA.—*Mammalia.* Presence of Amynodon and Selenodont Artiodactyla. Absence of Pantodonta and Dinocerata (Scott).

The facies of this fauna is more modern than that of the Bridger, and is clearly intermediate between it and that of the White River. One area is known, which is south of the Uinta Mountains, in the northeastern part of Utah. The thickness of the beds is not great, according to King.[49]

AMYZON BEDS.[50]—The exact horizon of this formation is not yet determined, but it is probably at the close of the Eocene or the opening of the Miocene. It is almost exclusively known palæontologically from fossil fishes, and these can be compared with those of the Green River shales. The characters are: Presence of Catostomidæ, Siluridæ, and Trichophanes. Absence of Osteoglossidæ, Gonorhynchidæ, and Chromididæ.

The only point of affinity with the Green River fauna is the presence of Trichophanes, which is nearly related to Amphiplaga of the latter.

There are three widely-separated localities of this formation. One is in the South Park of the Rocky Mountains, Colorado, another at Elko and Osino, in Northeastern Nevada, and the third is in Central Oregon, where it lies, according to Condon, immediately below the John Day formation.

MUTUAL RELATIONS OF THE EOCENE FORMATIONS.—Where the Bridger beds rest on the Wasatch, which I only know to be the case in the Washakie basin, in Wyoming, they are conformable. The Uinta beds are, on the contrary, not conformable to the Bridger beds, according to King.[51] The relations of the Wind River beds to the Wasatch remain undescribed.

MIOCENE SYSTEM.

The formations of the Miocene in the interior of North America are the following:

Loup Fork,
Ticholeptus,
John Day,
White River.

These horizons represent succession in time. A formation whose relation with the Loup-Fork epoch is yet uncertain has been named "The Dalles."[52] The four series each possess well-marked faunæ, whose distinguishing features are enumerated below.

WHITE RIVER.—*Mammalia.* Presence of a few Lemuroidea (?) and Creodonta, Amynodon (Scott and Osborn), Hyracodon, Cryptoproctidæ, Poëbrotheriidæ, Tragulidæ, Elotheriidæ, and Menodontidæ. Absence of Felidæ, Ursidæ, and Rodentia, except Sciuridæ and Leporidæ; of Camelidæ, Equidæ, and Proboscidia.[53]

There are three areas of this formation. The most extensive is the most southern, and occupies a large tract along the White River, in Northern Nebraska[35] and Southern Dakota, and extends westward into Wyoming and southwestward into Northeastern Colorado. The second is much smaller, and is situated in Central Dakota, two hundred miles north of the nearest point of the southern tract.[54] The northernmost White River formation is in Southern Canada, in the district of Assiniboia, and is intermediate in extent between the two previously-mentioned areas.[55] Some faunal differences have been noticed between these areas, which may be due to geographical distribution, imperfect observation, or slight difference of age. Thus, in the Central Dakota area, Hyænodon, Hyracodon, and Poëbrotherium have not yet been found. In the Canadian tract[57] neither of these forms has been found, and a genus of Creodonta (Hemipsalodon) is as yet peculiar to it. The thickness of the beds is as follows:

	Feet.
Nebraska (Hayden)[56]	150
Central Dakota (Cope)	200

The White River series corresponds to the Oligocene of some authors. Thus there occur in both Europe and America at this period the genera Elotherium, Hyænodon, Cynodictis, Ischyromys (= *Sciuromys* teste Schlosser in litt.), ? Pterodon (? *Hemipsalodon* teste Schlosser in litt.), and Agriochœrus (? *Haplomeryx*). Other European Oligocene genera occur in the John Day series, as Meniscomys (= *Sciurodon* teste Schlosser in litt.) and (? = *Aelurogale*) Archælurus (Schlosser in litt.).

JOHN DAY.—*Mammalia.* Presence of Nimravidæ, Poëbrotheriidæ, Tragulidæ, Elotheriidæ, Suidæ, Muridæ, and Saccomyidæ. Absence of Lemuroidea and Creodonta; of Hystricidæ, Felidæ, Ursidæ, Camelidæ, Equidæ, and Proboscidia.[53]

This formation occupies a considerable tract on the upper part of the course of the John Day River in Oregon. King states that it extends north into Washington and south into Nevada,[58] but, according to White, the beds from the latter State, to which King gave the name Truckee, are of later age. According to Marsh the John Day beds have a thickness of four or five thousand feet. The vertebrate fauna is very rich.

The beds in the valley of the North Fork of the John Day River present some faunal peculiarities, but their significance is unknown.[59]

TICHOLEPTUS.[59]—*Mammalia.* Presence of Anchitherium, Proboscidia, and Camelidæ, and the Oreodont genera Merycochœrus, Merychyus, Cyclopidius, and Pithecistes. Absence of ? Elotheriidæ, ? Poëbrotheriidæ, ? Nimravidæ, and Cosoryx.

This horizon requires further exploration, as but twenty species have been thus far determined from it. But it is evidently intermediate in age between the John Day and Loup Fork epochs, with greatest affinities to the latter.[60] It differs from the latter in the presence of Anchitherium and numerous genera and species of Oreodontidæ, and in the absence of Cosoryx. The formation is known from three regions: first, from Western Nebraska; second, from the valley of Deep River, Montana; and third, from Cottonwood Creek, Oregon. Its thickness has not yet been stated.

Loup Fork.—*Mammalia.* Presence of Felidæ, Camelidæ, Equidæ, Proboscidia, Cosoryx, Glyptodontidæ, and Hystricidæ. Absence of Tragulidæ, Oreodontidæ (with very few exceptions), Poëbrotheriidæ, Elotheriidæ, and Nimravidæ.

This formation has a wide extent throughout North America. The largest area overlies the White River [61] beds in Nebraska, Wyoming, and Colorado,[62] extending south and east of that formation into Kansas,[63] where it rests on the Cretaceous. There is a second area in Northern Central New Mexico,[64] and one perhaps in Southern New Mexico, extending from the Rio Grande to near the Arizona border.[65] There is another tract in Washington County, Texas; and yet another in Mexico, on the boundaries of the states of Hidalgo and Vera Cruz.[79] According to King its thickness in Wyoming reaches two thousand feet, but it thins out gradually to the eastward, so as to have a thickness on the White River of about one hundred and fifty feet, according to Hayden.

This formation was referred to the Pliocene series by King and Hayden, and I have called it Upper Miocene. The latter view is supported by the presence of the following European Miocene genera and species: Cosoryx, Palæomeryx (= Blastomeryx); Castor div. Steneofiber; *Mastodon* (*Tetrabelodon*) *angustidens*. The remaining Oreodontidæ (Merychyus) give it a facies older than Pliocene.

This series has received the name of Niobrara [66] from Marsh, a term previously applied to a division of the Cretacic. It includes the Humboldt,[67] and probably the North Park formations of King.[68]

PLIOCENE.

Under this head I include everything between the Miocene and the glacial epoch. It includes the following divisions. Two of them are consecutive in time, viz.:

Equus beds,

Idaho.

Two others are probably contemporary with one or both of the preceding, so that the names have only a provisional utility.

Megalonyx beds.

Truckee.

IDAHO.[69]—Present: Mammals, Camelidæ, *Equus excelsus;* Fishes, Cobitidæ, Percidæ, Siluridæ, Raiidæ, Mylocyprinus (Cyprinidæ), and peculiar species of existing genera of Cottidæ, of Salmonidæ, Catostomidæ, and Cyprinidæ. Absent: mammals, *Elephas primigenius*, etc.

The Mammalian fauna of this epoch is little known, owing to the rarity of remains. Its characters may be chiefly learned from the numerous fresh-water fishes it contains, by which it may be compared with the Equus beds, which also contain many fish remains. But one area of this epoch is known. It covers the southern part of Western Idaho, entering Eastern Oregon.

TRUCKEE.—The typical locality of this formation is the Kawsoh Mountains in Western Nevada. The formation was supposed by King to be identical with the John Day Miocene, but Dr. C. A. White informs me that it is of much later age. Vertebrate remains have been found, but have not been fully determined. Thickness (King), two thousand three hundred feet.[70]

EQUUS BEDS.[71]—Present: Glyptodontidæ (Mexico), Megatheriidæ, Eschatiidæ; extinct genera, Holomeniscus, Mastodon (Mexico), Smilodon (Texas); extinct species, *Elephas primigenius;* Equus, four species; Lutra, Cervus, etc.; recent species of Thomomys, Arvicola, Castor, Canis, ? Homo. Absent: Cosoryx, Oreodontidæ, Protolabididæ; Raiidæ, Cobitidæ, Mylocyprinus, and the fishes of the Idaho beds in general; Castoroides and Amblyrhiza.[72]

The localities of this formation are widely distributed. In the presence of various extinct forms, above mentioned, it agrees with the Pampean fauna of South America, but differs in the presence of the northern existing genera and species with the extinct *Elephas primigenius.* The Argentine forms drop off successively as we travel northwards. Thus, Macrauchenia ceases in Bolivia, Toxodon in Nicaragua (Leidy), Glyptodon in the valley of Mexico (Barcena), where *Elephas primigenius* commences. Where the line should be drawn between the Pampean and Equus beds I do not know, but we can arbitrarily assume it to be the line of distribution of the *Elephas primigenius.* This will include the fauna of the valley of Mexico, which has also other forms common to the more northern areas. Such are four species of Equus,—one of Bos, one of Eschatius, one of Holomeniscus (Camelidæ), and one of Platygonus.

The areas of the Equus beds are, then, the valley of Mexico,[73] Southwest Texas,[74] Carson, Nevada,[75] near Fresno, Southern California, the Oregon Desert,[76] Western Nebraska, and probably other localities. The beds are nowhere of great depth.

The presence of Homo in the beds of this epoch in Oregon was indicated by me in 1878.[77] This discovery has been confirmed by the discovery of obsidian implements in place, in Western Nevada, as affirmed in a recent publication[78] of Mr. G. K. Gilbert of the United States Geological Survey in *Nature.* This gentleman has expressed the belief that the beds of this age are not older than the glacial epoch, because they embrace the bases of some of the moraines of some of the ancient glaciers of the Sierra Nevada. It remains to be proven, however, that these moraines are of true glacial age, since they are of entirely local character. The presence of so many mammals of the fauna of the valley of Mexico would not support the belief in a cold climate.

THE MEGALONYX BEDS.[72]—This formation is chiefly represented in the caves of the Eastern States. Its fauna is as follows: Present: Megatherium, Mylodon, Megalonyx, Castoroides, Amblyrhiza, Anomodon, Arctotherium, Smilodon, Platygonus, Mastodon, of extinct genera; and of recent genera, Sciurus, Arctomys, Jaculus, Arvicola, Erethizon, Hydrochœrus, Lagomys, Lepus, Scalops, Procyon, Canis, Mustela, Equus, Tapirus, Dicotyles, Cariacus, Bos, Didelphys. Absent: Glyptodontidæ, *Equus crenidens, occidentalis*, and *barcenæi;* Eschatiidæ, Holomeniscus.

It is not certain that this fauna does not owe its peculiarities to geographical causes only, and was not entirely cotemporaneous with the epoch of the Equus beds. Its relations to that of the glacial epoch are not yet fully defined.

PLISTOCENE SYSTEM.

This system is represented by but few deposits in the interior of North America. Therefore it is touched on but lightly in this report. The consecutive epochs which it embraces are the following:

Later Glacial,
Champlain,
Early Glacial.

The faunæ of these periods have not yet been discriminated. As the Champlain was a time of submergence, the species of marine vertebrata may be properly attributed to it. Characteristics of the Plistocene fauna are the following: Present: *Mastodon americanus, Cervalces americanus, Beluga vermontana, Trichechus rosmarus, Rangifer tarandus, Ovibos bombifrons, Bos americanus, ?Felis atrox, Canis lupus, Ursus horribilis, Mallotus villosus.* Absent: Megatheriidæ, Tapirus, Dicotyles, Platygonus, Amblyrhiza, Arctotherium, Smilodon.

The localities at which fossils of the glacial epoch occur are scattered over the entire continent east of the Plains, and their equivalents occur of course over the west. Many questions of exact contemporaneity of these different beds are as yet unsettled.

Total thickness of the Cænozoic Realm:

	Feet.
Eocene	12,000
Miocene	7,000
Pliocene	? 1,000
Plistocene	? 1,000
	21,000

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EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

To the student of natural science to-day a knowledge of German has become all-important. He *must* read the productions of our Teutonic cousins. Possibly next in importance of foreign tongues comes French, but there are many others of which one must have at least a smattering. There is, however, a limit to the linguistic attainments of the student of science, and soon some International Scientific Congress will have to decide the question of what language or languages shall be recognized. Every year sees the establishment of new journals in what might be termed "outlandish" tongues. The languages of Scandinavia are bad enough, but what shall we do with the facts buried in Russian, Finnish, Polish, Bohemian, and Hungarian treatises? Are they to be ignored? or must we all become polyglots? The writer recently asked an eminent German professor if he read Russian. His answer states the whole question. "No. If some stupid writes his descriptions in Japanese, must I thereupon study Japanese?" It is time to cry a halt in this direction. The possibility of a literature of science in Japanese is not so remote, unless there be some universal agreement in regard to the language in which scientific discoveries must be clothed in order to claim early recognition.

We do not know the merits of "Volapük" as a medium of scientific publication, but we suggest that the time is at hand when that or some other common language will have to be formally adopted by scientific authors.

Dr. T. N. Gill writes an article for the *Forum* (of New York) on the possible existence of a sea-serpent. He regards as unreliable most of the stories of its alleged appearance, but says that if existing, it is more likely to be a snake-like Cetacean or shark than anything else. In the succeeding number, Professor R. A. Proctor, the astronomer, asserts the strong probability that the sea-serpent exists, and that, if so, it is likely to prove to be a remaining species of the Mesozoic saurians. If Professor Proctor were as good a zoologist as he is an astronomer, he would perceive that this supposition is quite outside the range of scientific probability, and that those of Professor Gill are much more likely to prove true.

RECENT LITERATURE.

Wortman on the Teeth of the Vertebrata.[1]—We have in this monograph a work which students of odontography will find it to their advantage to consult. Dr. Wortman's excellent opportunities in the museums of the country have been improved so as to enable him to present the latest results of research among the extinct as well as the recent Vertebrata. The subject is approached by analytic tables of the systematic arrangement of the various divisions of this branch of the animal kingdom. In the history of the origin of teeth he has sought the latest embryological works, and gives us a well-digested account of the results. He

[1] Comparative Anatomy of the Teeth of the Vertebrata. By J. L. Wortman, M.D. Reprinted from The American System of Dentistry. Pp. 153. 1886.

advances a theory of dental succession which is opposed to the prevalent one, and which, as it appears to us, accounts better for the facts. It is thus stated (p. 500): "In the Batrachia and Reptilia there are many sets of teeth developed during the life of the individual, of which the first arises *de novo*, and all the succeeding ones are derived from that which precedes it. Altogether, I am disposed to regard the diphyodont mammalian dentition in the same light: those teeth which take their origin primarily from the epithelial lining of the mouth are strictly homologous with the first set of the lower vertebrates. This would include in the first set the deciduous incisors, canines, molars, and the first true or permanent molars. The second set of the batrachian and reptile would be represented by the permanent incisors, canines, premolars, and second true molar. The third succession would be represented by the last molar of the diphyodont dentition."

The monograph is well illustrated by wood engravings.

Kedzie's Gravitation, Solar Heat, and Sun-Spots.[1]—Professor Kedzie's interesting book makes a sensible addition to the light necessary to the understanding of that form of energy known as gravitation. He starts with the kinematists in refusing to credit the existence of attraction, or the action of matter where it is not, and uses the Le Sagian idea of external pressure as the principle of gravitation. But he differs from Le Sage in not admitting this force to be derived from hypothetical molecules, and in asserting that it is the mechanical energy due to vibrations of the ether moving towards the sun. He goes further and attempts to account for the source of this energy. He regards it as the equivalent of the heat which is radiated from the suns of the universe into space in such prodigious quantities, which is metamorphosed into mechanical energy and returns to its source in this form. The reasons for believing in the return are thus stated. Assuming space to be infinite, and to be full of the ether, he conceives the latter to be full of energy. Any addition to this energy from any source will cause an overflow, which will naturally be in the direction of the region from which the emission took place. Hence between the sun and the surrounding space there is an endless cycle of outgoing and incoming energy. The reason why this returns as mechanical and not as thermal vibrations he supposes to be as follows. The conversion of mechanical motion into heat being caused by resistance or contraction of space, the reverse process of converting heat into mechanical movement will result from the opposite physical condition; *i.e.*, the reduction of pressure and expansion of space.

[1] Solar Heat, Gravitation, and Sun-Spots. By Professor J. H. Kedzie. 8vo, 1886. S. C. Griggs & Co., Chicago.

Hence heat is thus changed at a proper distance from the sun. The only adverse criticism we have to offer to this theory follows Professor Kedzie's assumption that the physical basis of universal energy (the ether) is of infinite extent. If this be assumed, his other assumption, that it is *full* of energy, falls to the ground: it could never get full, and energy radiated into it would be truly lost and would never return. If, now, the ether be supposed to have a limiting boundary, Professor Kedzie's theory has a much more certain basis, and, indeed, so far as regards the necessary return of energy, may be fully accepted.

Professor Kedzie advances the theory that sun-spots are dynamic shadows or regions of lower temperature. These are due to the diminution of the quantity of heat generated on the surface of the sun in consequence of the interception and appropriation as gravitation by the planets, of the energy returning to the sun from space.—*C.*

Cope's Origin of the Fittest.[1]—Under the title of "Origin of the Fittest" Professor Cope has collected into book form the various essays which he has published during the last twenty years upon the subject of evolution. During this time Professor Cope has won for himself a leading position among American naturalists, not only as an investigator, but as a thinker. To him is largely due the origin and growth of what is sometimes called the American school of evolution, or Neo-Lamarckism. It is in the essays embodied in the book before us that he has advanced his views and formulated the beliefs of this school.

It is to be regretted that Professor Cope did not see fit to revise these essays and arrange the subject-matter in them into a systematic form. As it is, he has simply reprinted them as they were originally published, with only here and there a note. Some of the chapters are prize essays, some detail results of original investigation, and some were popular lectures. They were written at various times and for all sorts of purposes. There is a deal of repetition and self-quotation. Published in this form, there cannot fail to seem a lack of unity. The reader finds difficulty in discovering any obvious thread to bind the essays into one book, and much of the interest and suggestiveness is lost thereby. Professor Cope promises us in the—let us hope not distant—future a systematic summary of the subject. But this book must be taken for what it is intended,—not as a separate publication or a connected summary, but simply as a collection of the writings of the author.

In the pages of this book may be found the views of the American Neo-Lamarckian school; for although it contains the

[1] The Origin of the Fittest. By E. D. Cope, A.M., Ph.D. 8vo, November, 1886. D. Appleton & Co., New York.

works of Professor Cope alone, it nevertheless embodies the views of others who have been associated with him in similar work, and it may be taken therefore as expressing more fully than any other publication the substance of Neo-Lamarckism. The teachings of this school as expressed by Professor Cope are briefly as follows:

1. Darwin's law of natural selection, or the survival of the fittest, is secondary to the question of the *origin* of the fittest; *i.e.*, variations. According to Darwin, organisms have an inherent tendency to vary, and variations are fortuitous.

2. Professor Cope denies any inherent tendency to vary. There are no tendencies except growth and heredity.

3. Variations are due to

(*a*) Physical and chemical effects of environment.

(*b*) Use and disuse. The effect of use and disuse in the individual is plainly seen, and can be shown in successive generations by palæontological evidence.

(*c*) Consciousness implying effort producing motion. The object of the effort is to satisfy hunger or to give pleasure; the result is variation in the parts used. Sensibility is therefore an important factor in producing variation.

4. The results of physical selection and of use and disuse are constant, those of natural selection more or less fluctuating.

5. Separate groups may vary independently in the same or similar directions owing to the action of similar conditions.

6. These features of variation appear usually in adults. But by acceleration they are inherited in younger stages. Embryology thus becomes crowded and many useless stages are skipped. By retardation variations may be inherited by later stages.

Some of Professor Cope's personal views most worthy of note are these:

Consciousness is a primeval attribute of matter. It was the cause and not the result of organization. All adaptive actions were originally conscious, and this is true even of reflex and automatic actions and of many motions of plants.

Genera are not merely exaggerated species, as Darwin believed, but have had a different sort of origin, so that the same species may be carried from one genus to another.

In regard to the value of these various conclusions there is of course room for great difference of opinion. The most important conclusions are those relating to physical selection and the effect of use and disuse. Professor Cope has here certainly attempted to fill a need distinctly felt by naturalists. The origin of variations and the laws regulating their appearance are at the bottom of all views of descent. Darwin himself has recognized the great difficulty in accounting for the origin of species by the selection of mere chance variations; but he looked upon use and disuse as

PLATE XVI.

PLATE XVII.

playing only a small part in the matter. Professor Cope and the others who go with him regard use and disuse as the factor of most fundamental importance in producing the variations upon which natural selection can act. The essays of this volume are therefore of great value and full of suggestiveness. They mark a phase in the advance of the evolution problem. They cannot be hurriedly read, but demand careful study on the part of all who wish to comprehend the modern aspects of biological problems. In them every one will perhaps find something with which he will not agree, and many may dispute the general conclusions, but no one can read them without profit. For we must recognize that Professor Cope has attempted to answer a question lying below the law of natural selection. He has attempted to show why variations appear when they are needed and how it is that many animals may vary simultaneously in the same direction. It is hardly time to pass judgment upon his views, but it certainly seems that the observations and suggestions embodied in this book remove many of the difficulties which have been found in the way of the descent theory when viewed from the stand-point of pure Darwinism.

The accompanying plates taken from the book illustrate the remarkable parallelism between genera of different families, called by Professor Cope heterology. Plate XVI. represents five types of the new world Iguanidæ, and Plate XVII. as many of the old world Agamidæ.—*H. W. Conn.*

Geyler and Kinkelin's Pliocene Flora.[1]—Besides the Pliocene deposits of Germany enumerated, 1875, by Sandberger there are two more Pliocene basins,—Hanau-Seligenstadt and Niederrad-Floersheim. The plants of these basins indicate a climate similar to that of the present time and are considered as "Upper Pliocene." About thirty species are described and figured. Of these there are six species identical with recent North American forms, and four extinct species have their nearest relatives among the North American Flora. Six species are recent European forms and seven others are extinct. Seven forms are described as new species; they belong to the genera Pinus, Abies, Fagus, Liquidambar, Rhizomites, and Potamogeton. Several plants, referred to the Oligocene by Ludwig, are Pliocene.

[1] Die Oberpliocaen Flora aus den Baugruben des Klaerbeckens bei Niederrad und der Schleuse bei Hoechst a. M. 47 pages, 4to, 4 plates. By Th. Geyler u. F. Kinkelin. Abhandl. d. Senckenberg. Naturforsch. Gesellsch., 1887.

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

American Triassic Rhynchocephalia.—The reptilian genus Typothorax was described by the writer in 1875 in the report of Captain G. M. Wheeler to the Chief of Engineers, U. S. A., from peculiar osseous dermal plates, which he found in the Triassic bad-lands of New Mexico. Additional material recently examined furnishes a good deal of information as to the characters of this form, and indicates that its position is somewhere near to the genus Aëtosaurus of Fraas, in the order Rhynchocephalia. This is an important addition to American palæontology, since undoubted members of this order have not been hitherto found on this continent, excepting perhaps the Champsosauridæ.

The pieces, which belong undoubtedly to the type species, *Typothorax coccinarum* Cope, include two ribs with corresponding dermal scuta, two femora, and some loose dermal scuta. There are probably other parts of the animal preserved. The ribs are remarkable for their wide expansion, so that their edges meet, forming a continuum; but they are not joined suturally. Each rib is overlaid by a band-like dermal scutum of similar length and width. The inferior face of one edge of the dermal scutum is bevelled so as to make a gaping groove, while the plate and rib are obtuse and appressed at the opposite edge. This edge is probably received into the gaping edge of the adjacent pair of bones, thus forming an uninterrupted cuirass, as in the armadillo. The femur is curved, with a third trochanter and a bilobate external condyle. No distinct great trochanter. The dermal armature resembles that of Aëtosaurus, but differs in being in continuous bands, instead of being subdivided by cross-sutures. The ribs of Aëtosaurus are not represented as expanded by Fraas; but we do not know the characters of all of them in either genus. The surface of the scuta is sculptured into shallow pits in *Typothorax coccinarum*. The species is as large as the Mississippi alligator.

This genus offers an interesting parallel in the structure of its carapace to the early stage of the same part in some of the tortoises. The incomplete fusion of the ribs and the distinctness from them of the dermal osseous deposit, are conditions of embryonic stages in that order. There can be little doubt but that more complete knowledge of this genus and its allies will throw light on the origin of the order of Testudinata.

It is important to observe that, like the Aëtosaurus in Würtemberg, the Typothorax accompanies the genus Belodon in the beds near the summit of the Trias.—*E. D. Cope.*

Some New Tæniodonta of the Puerco.—A right mandibular ramus from the upper beds of the Puerco formation in New Mexico indicates a species of Psittacotherium different from the two hitherto known (Hayden's "Report U. S. Geol. Surv. Terrs.," iii., Bk. I., p. 196, 1885), and of larger size. One cutting anterior tooth (the supposed external incisor) is preserved, and the alveolæ of all the molars, with the entire second molar free from the jaw. These fragments indicate the most robust of all incisor-biters known, and an animal capable of doing great execution with the front teeth. The depth of the ramus at the symphysis is remarkable, equalling the length of the entire molar series *plus* half the long diameter of the incisor. The long diameter of the incisor equals the space occupied by the anterior three molars; in *P. multifragum* this diameter covers but two molars. The enamel of the incisor is smooth; in *P. multifragum* it is grooved. The premolar preserved is similar to that of the *P. multifragum* in form, but is larger; it consists of an external larger and an internal smaller conical cusp and a single compressed root; the inferior border of the enamel angulating upwards on each side. Length of entire dental series, m. .095; diameters of incisor,—anteroposterior, .028; transverse, .016; depth of symphysis, .085; depth at fourth molar, .050; diameters of second molar (premolar),—anteroposterior, .010; transverse, .017; elevation of external cusp, .018.

This species may be named *Psittacotherium megalodus.*

The anterior part of the palate, with two of the characteristic teeth of the *Psittacotherium multifragum*, supplies a hiatus in our knowledge of the genus. A powerful rodent-like incisor occupies the inner edge of the premaxillary bone. It is narrowed and produced posteriorly, but the enamel only covers a narrow part of each side besides the front, the entire surface being without angles. Enamel rugulose and delicately grooved. Posterior to this tooth is a diastema about as wide as its crown. This space is succeeded by a huge tooth in the position of a canine, but whether truly such is uncertain. Its section is oval, and the long axis is directed obliquely outwards and forwards. Its enamel is delicately rugose and grooved, but a wide open channel on the anterior half of the external face is the most conspicuous peculiarity. The apex of the crown is lost. No diastema behind this tooth. The dimensions of this tooth are about those of the external incisor of *Psittacotherium multifragum*, and the enamel is similarly marked.—*E. D. Cope.*

Mr. Hill on the Cretaceous of Texas.—In our February number we referred to the reading of a paper by Mr. Robert Hill, of the United States Geological Survey, on the Cretaceous formations of Texas. In this paper Mr. Hill makes the important announcement of his discovery of a series of beds below the

Dakota formation, which fill the extensive hiatus which has hitherto existed in American geology in the region of the lower Cretaceous. The text of this paper having come to hand in the *American Journal of Science and Arts* for April, further observations on it are possible. The formations discovered below the Dakota are referred to a single series, under the name of the Comanche. This is divided into two divisions, which receive new names; and these are again subdivided lithologically into five and four subdivisions respectively, several of which have been previously named by Marcou and others. The Comanche series is said to be "one of unbroken sedimentation and faunal continuity from base to top." We fail to perceive, therefore, why they should be arranged in two divisions, each of which receives a new name, the more as no characters, faunal or lithological, are cited in support of them.

In the same paper the Upper Cretaceous beds of Texas are reclassified, and the whole are arranged in an upper series, which includes the Cretaceous formations of the Gulf States. To this body of formations the name "Gulf Series" is given. We must protest against the introduction of this name also, not only because no characteristic definition of the division is given, but because we believe that no such definition is possible. The Cretaceous of the Atlantic States is susceptible of intercalation with the beds of the Gulf States, and the name "Gulf Series" is not only inappropriate for them, but any name for them as a whole is unnecessary. This is because the Atlantic beds can be intercalated with those of the interior of the continent. That some of the Texan beds are identical with some of the latter is well known. Thus the Niobrara epoch is well represented in Northern Texas both by its well-known vertebrate fossils and its characteristic chalk, a fact apparently unknown to Mr. Hill.

The Upper Cretaceous series is divided by Mr. Hill into four divisions, named respectively (beginning at the top) Navarro beds, Dallas Limestones, Eagle Ford Shales, and Timber Creek group. Of these the first two are probably identical with the Riply and Rotten Limestone beds of Mississippi and Alabama, and the Eagle Ford Shales are likely to prove to be the same as the Eutaw group of Hilgard, Tuomey, and others. The name "Timber Creek" is already in use for a division of the Upper Cretaceous in New Jersey. This duplication of names is not sustained by any reasons, but, on the contrary, the writer refers to previous determinations by Shumard, without correction.

There is enough good and new work indicated in this paper to satisfy the ambition of a discoverer, and to attract the attention and interest of geologists. But the author has failed to appreciate the importance of observing the ordinary rules of nomenclature to a degree which is surprising.—*E. D. Cope.*

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—A few specimens of basic eruptive rocks have recently been described by Schmidt[2] from the north side of the Central Alps in Switzerland. Near Iberg, in Canton Schwyz, a diabase porphyrite occurs cutting *Eocene* deposits. This porphyrite presents all the characteristics of pre-Tertiary porphyrites. It offers another proof of the fact that texture in rocks depends more upon the conditions under which the rock magma solidified than upon the age during which it was erupted. The porphyritic crystals are oligoclase. Many of them consist merely of an outer shell of plagioclase substance, including material identical with that of the ground-mass. Melaphyres from near Glarus contain olivine crystals, which have undergone the unusual alteration into bastite.——Messrs. Barrois and Offret[3] have found that the rocks of the Sierra Nevada Mountains in Southern Spain are similar in many respects to those of the Ronda[4] Mountains. They consist principally of a series of highly-altered schists and limestones. The mica schists of this series contain in addition to their essential constituents the accessory minerals rutile, tourmaline, garnet, muscovite, kyanite, sillimanite, andalusite, and occasionally feldspar. Garnet and staurolite are among the oldest constituents. Their shattered condition shows that the rock in which they occur has been subjected to great pressure. The Cambrian schists of this region are divided into sericite schists and chloritoid schists. Members of both series are cut by veins of quartz, with which are associated fluorine minerals, a fact which leads the authors to regard these as the products of the action of gaseous emanations upon the material of the surrounding rock-masses. Among the Cambrian amphibolites is mentioned a variety containing glaucophane, with a greenish-blue tint instead of a violet-blue color parallel to $\mathfrak{b}$. The composition of this glaucophane is:

SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	loss at red heat
47.42	8.42	9.68	15.28	12.95	2.97	4.16

——A dyke of diabase cutting the old red sandstone near Dumbarton, Scotland, is described by Lacroix[5] as presenting a fine example of the existence in the same rock-mass of three distinct types of structure,—the devitrified glassy, the porphyritic, and the ophitic.——The analyses of several rocks from the neighborhood of Christiania, Norway, have recently been published.[6] The rocks analyzed are, with one exception, from the area occu-

[1] Edited by Dr. W. S. BAYLEY, Madison, Wisconsin.
[2] Neues Jahrb. f. Min., etc , 1887, i. p. 58.
[3] Comptes Rendus, ciii., 1886, pp. 174 and 221.
[4] *Cf.* American Nat., Notes, June, 1886, p. 549.
[5] Comptes Rendus, ciii., 1886, p. 824.
[6] Jannasch, Ber. d. deuts. chem. Gesell., 1887, i. p. 167.

pied by the prädacite of Lang, and its contact zone. By comparison of the composition of an unaltered slate with that of a hornfels produced by its alteration, it is seen that in this process water and carbon dioxide were driven off, and the ferric iron in the former was reduced to the ferrous state in the latter. The brown mica of the hornfels contains 3.40 per cent. of titanic oxide.

Fulgurites.—Although the interesting bodies known as lightning-tubes have been the subjects of numerous papers during the past century, it must be confessed that our knowledge in regard to them is not very extensive. The United States National Museum having recently become possessed of several fine specimens of the tubular varieties formed by lightning striking in loose sand, Mr. G. P. Merrill[1] has been enabled to study these microscopically, and thus to add something to our previous knowledge of them. In all the cases examined the walls of the tubes consisted of glass, in which there were no traces of crystallization. Analyses of the glass and of the sand in which the fulgurites are found and by the fusion of which they were produced, show that in every case the former contains more silica than the latter. The author argues that "had the lightning shown no selective power the resultant glass would possess the same composition as the sand in which it formed. Had it exercised such power one would naturally expect the most fusible minerals to be first acted on, and hence that the glass would approach them in composition." But the contrary of this seems to have taken place, the ordinarily infusible quartz having been most acted upon. This may probably be explained by supposing the quartz to offer the greatest resistance to the passage of the electric current, —*i.e.*, to be a very poor conductor of electricity. It would then in consequence of this resistance become heated even to the point of fusion, while the better conductors would escape with little injury. The resulting glass would in this case have a higher percentage of silica than the surrounding sand. The actual composition of glass and sand from Union Grove, Whitesides County, Ill., yielded Professor Clarke:

	Loss on ignition	SiO_2	$Fe_2O_3.Al_2O_3$	CaO	MgO	K_2O	Na_2O
Fulgurite glass..........	0.33	91.66	6.69	0.38	0.12	0.73	0.77
Sand......................	1.01	84.83	9.88	1.16	0.13	1.13	1.50

The paper concludes with a very full bibliography of the subject.

Mineralogical News.—A variety of the rare mineral *carphosiderite* is described by Lacroix[2] from the triassic arkoses of Màcon (Saône-et-Loire). It occurs as micaceous coatings of a

[1] Proceedings of United States National Museum, 1886, p. 83.
[2] Comptes Rendus, ciii., 1886, p. 1037.

golden-yellow color on the walls of cavities and cracks. Examined microscopically, it is seen to consist of pleochroic (colorless and pale yellow) needles in a light yellow non-pleochroic ground-mass. Under crossed nicols the former show bright polarization colors, while the latter remains unchanged during a complete revolution, and is therefore regarded as being made up of the same acicular crystals cut perpendicular to their optical axes, which are negative. The specific gravity of the mineral is 3.09. It is infusible, and when heated in a glass tube gives off water and sulphuric acid. Its composition is:

$$SO_3 = 30.18, P_2O_5 = 2.72, Fe_2O_3 = 48.52, H_2O = 18.48.$$

——In the same journal Gonnard[1] describes pleromorphs of *quartz* after *fluorite.* Curious blocks of milky quartz from St. Clement (Puy de Dôme) are seen, upon close examination, to be made up of spherules composed of acicular crystals of quartz radially arranged around a centre, which is sometimes a void, but more frequently a piece of granite or a core of amorphous silica. Scattered through the blocks are found cavities of octahedral form, normal to the faces of which the quartz-fibres are arranged. Inside of the cavities are also occasionally little octahedrons of quartz with their faces parallel to the walls of the cavity.——Several doubtful minerals have recently been examined microscopically by Dr. Lacroix.[2] *Pterolite,* which Dana supposed to be an altered lepidomelane, Lacroix found to be a mixture of several distinct minerals, of which the most important are a black mica and a strongly pleochroic pyroxene. In addition to these there are also present in pterolite numerous grains of blue sodalite, rhombohedra of calcite or dolomite, and many other minerals which are usually found in eleolite syenites. *Villarsite* is shown to be merely a pseudomorph of chrysotile after olivine. *Gamsigradite* has the optical properties of hornblende, with a maximum extinction of 30° and pleochroism in green and brown tints.——In a late number of the *Neues Jahrbuch für Mineralogie* F. Sandberger[3] discusses the widespread occurrence of iodine in phosphorites, of lithium in psilomelane, and of cassiterite and anatase crystals in zinc-blende and in tetrahedrite. He also describes hexagonal plates of *kaolin,* which he thinks are orthorhombic crystals bounded by the planes $0P$, $\infty P\breve{\infty}$ and ∞P. They are found in the clefts and druses of a quartz vein occurring on the contact between a lithium-mica granite and a mica schist at the Morgenstern Mine, Joachimsthal. ——In connection with his work on mineral veins the same author[4] had occasion to examine the mica of the Schapbach gneisses and the augite of a diabase from near Andreasberg, Harz. In each he found a silver content of about 0.001 per

[1] Comptes Rendus, ciii., 1886, p. 1036. [2] Ib., civ., 1887, p. 97.
[3] Neues Jahrb. f. Min., etc., 1887, i. p. 95. [4] Ib., p. 111.

cent.——The crystals of *phenacite* occurring at various localities in Colorado, according to Mr. Penfield,[1] possess a great similarity of habit to those from the Ilmengebirge, Urals. The phenacite from the Pike's Peak region (as well as the amazon stone and smoky quartz from the same locality) is found in pockets in the neighborhood of the Crystal Peaks,[2] a chain of granite hills about fifteen to twenty miles northwest of Pike's Peak. The crystals from this place are usually small in size, the largest ever found measuring but 15 mm. in length. Most of the crystals are colorless, but those entirely imbedded in gangue have a faint wine color.——Mr. A. N. Alling[3] has recalculated the physical constants for topaz from measurements of a crystal of this mineral from Thomas Range, Utah. The axial ratio as recalculated is $\check{a} : \bar{b} : c' = 0.5285 : 1 : 0.47715$. The optical angle, $2V = 67° 18'$; and the indices of refraction are $\beta = 1.6104$ and $\gamma = 1.6176$ for yellow light.

Chemical Integration.[4]—The author regards all chemical species known to us as units or integers produced by the identification in volume, or, in other words, the integration of more elemental species. Rejecting the atomic hypothesis which he has long regarded as, in the language of J. P. Cooke, "a temporary expedient for representing the facts of chemistry to the mind," the author designates the so-called molecular weights of species as their integral weights. They are, at the same time, equivalent weights, since they are the weights of equal volumes. The specific gravity at 0° and 760 mm. of hydrogen gas, which is the unit of combining weight, should, in his opinion, be made the unit of specific gravity for all species. The integral weights for gases and vapors are well known to be multiples of this unit of specific gravity, and, believing the law of condensation by volume to be universal, the author conceives all liquid and solid species to be formed by the condensation or so-called polymenzation of normal gaseous species often unknown to us. From this he concludes that the specific gravity of these liquids and solids should be calculated on the basis of hydrogen as unity. In this way the problem of the coefficient of condensation is solved.

We had long maintained that the law of progressive series is also, like that of volumes, universal in chemistry, applying not only to related hydrocarbons, but to species differing in the proportions of oxygen, of sulphur, of metals, and of hydrogen. In the existence of such series he finds an explanation of those apparent variations in the law of definite proportions, seen alike

[1] Amer. Jour. Sci., xxxii., Feb. 1887, p. 130.
[2] W. B. Smith, Ib., p. 134.
[3] Ib., xxiii., Feb. 1887.
[4] Abstract of paper read before Nat. Acad. Sciences, April 19, 1887.

in solid and in gaseous species, upon which several chemists have in late years insisted.

The question of heterogeneous and of homogeneous differentiation or disintegration in gases is also discussed at length, as well as several other related problems, all of which have been previously noticed in the author's lately-published volume, entitled "A New Basis for Chemistry," to which the present paper is a supplement.—*T. Sterry Hunt.*

Miscellaneous.—By subjecting mixtures of zinc salts and sulphates of sodium or potassium to a high temperature Alex. Gorgeu[1] has succeeded in obtaining little hexagonal prisms and plates of zinc oxide with the hardness and density of the natural *zincite.* By the addition of a small quantity of manganese sulphate to the mixture before heating, the crystals obtained possessed the pink color of the natural mineral. *Willemite* was produced by calcining a mixture of one part zinc sulphate, one-half to one part sodium or potassium sulphate, and one-thirtieth part hydrated silica. The crystals obtained were in the form of hexagonal prisms, terminated by an obtuse rhombohedron. They corresponded in all their properties with the naturally-occurring willemite.——Bourgeois[2] has effected the syntheses of several crystallized carbonates by heating their corresponding amorphous carbonate precipitates to a temperature of 100° in glass tubes containing a solution of some ammoniacal salt. Calcium, strontium, and barium carbonates crystallized as *calcite, strontianite*, and *witherite.* The first was accompanied by some aragonite. Lead carbonate crystallized as cerussite and hydrocerussite, and cadmium carbonate formed little crystals corresponding to calcite. The same results were reached by heating solutions of the saline salts with ammonium carbonate at 140°. ——Brazilian *topaz* possesses an electrical axis which does not correspond to any crystallographic axis.[3]——E. Cohen[4] has described pseudomorphs after the concretionary *markasite* occurring in the chalk at Rügen, Pomerania. The pseudomorphs are composed of a mixture of 9.88 per cent. silica, 11.93 per cent. copiapite, and 78.19 limonite.

BOTANY.[5]

Smut in Oats.—Some recent experiments made at the New York Agricultural Experiment Station upon the smut (*Ustilago segetum*) which affects the panicles of the oat are of such interest

[1] Comptes Rendus, civ., 1887, p. 120; Bull. d. l. Soc. Chim. d. Paris, xlvii., Feb. 1887, p. 146.

[2] Ib., ciii., 1886, p. 1088; Bull. d. l. Soc. Chim d. Paris, xlvii., Jan. 1887, p. 81.

[3] K. Mack, Pogg. Annalen, 1886, No. 6, p. 153.

[4] Sitzb. d. Naturw. Ver. f. Neuvorpommern u. Rügen, 1886.

[5] Edited by Prof. Charles E. Bessey, Lincoln, Nebraska.

that we reproduce here the substance of the account found in the fifth annual report of the station.

After repeated observations it was found that the loss by smut the past year in an oat-field upon the station was about eight and a half per cent. The question of the transmission of smut from crop to crop was taken up. Seed was procured from a very smutty field in another county and sown upon plats of ground variously situated. The results were as follows: Plat A, 28.81 per cent.; plat B, 30.86 per cent.; plat C, 11.68 per cent.; plat D, 21.49 per cent. The average for all was 23.21 per cent.

Ten other plats were sown with seed from the same field, but here the seed for each plat was treated with some substance supposed to be injurious to the spores of the smut. The results are given in the following table:

				Hours.	Per cent. of Smut.
Plat	E	soaked in	copper sulphate solution	17½	1.78
"	F	"	" " "	40	0
"	G	"	iron sulphate solution	17½	16.51
"	H	"	" " "	40	12.15
"	I	"	caustic potash "	17½	0
"	J	"	sodium chloride "	17½	4.07
"	K	"	potassic nitrate "	17½	10.21
"	L	"	cattle-urine	24	3.47
"	M	"	cattle-urine + quicklime	24	3.38
"	N	"	castile soap + water and quicklime	24	2.25

Two of the applications, it will be noticed, proved to be efficacious remedies,—viz., the copper sulphate and the caustic potash. The solution of copper sulphate consisted of four ounces dissolved in one gallon of water. The caustic potash solution was made by dissolving half an ounce in one and a half pints of water. It is stated that the treatment of the grain with the various substances seemed to produce no injurious effect upon the plants.

Students as Collectors.—By the time this note comes to the readers of the NATURALIST hundreds of classes in botany will be engaged in collecting material for study and for making into specimens. The amount of material gathered from the forests and fields is no doubt enough each spring to make a pretty large herbarium. And yet, if all these dried plants were brought together, how few of them would be really desired by the professional botanists of the country! A few Ranunculaceæ; several Cruciferæ; a good many Leguminosæ and Rosaceæ; all the violets obtainable; an Umbellifer or two, rarely more; several of the Rubiaceæ; some early and easy Composites, and so on to the grasses and ferns, make up the collections. The fifty or one hundred species in each collection are those which the pupil finds to be the easiest to obtain and identify of all that come under his notice. The early sedges and grasses he passes by, for the most part, while the mosses and lichens, the toadstools, the puff-balls, the rusts, smuts, etc., are all ignored as much as if they belonged to an entirely different domain of nature.

Let the teacher make the experiment of encouraging the collection and study of all kinds of plants. Let him, when a pupil brings a certain flattish fungus with many pores on its under surface, take a couple of minutes to direct attention to the pores, on the walls of which the spores are developed; to the tough mass of closely-interwoven threads which makes up the body of the fungus; to the fact that the plant is a saprophyte; and, at last, let the pupil be told that botanists call it *Polyporus versicolor*, and consider it to be somewhat related to the toadstools. When a spotted strawberry-leaf is brought, let the teacher tell something about its cause, even if it be but little. Let him show the pupil by a rough sketch or two the general nature of the parasite. Let the pupil be told to look for similar spots on other plants, and let him know that the name now applied to the species on the strawberry-leaves is *Ramularia tulasnei.* Do so with lichens, with pond-scums, green slimes, with mosses, with liverworts,—in fact, with whatever is brought in by the sharp-eyed young collector.

But many a teacher will say that such work is impossible to any but a professional botanist with a perfect acquaintance with all the plants of the flora. It is not necessary, however, that full details should be given regarding any plant brought by the pupil. He must be a poor teacher indeed who cannot suggest something to his pupil about a toadstool or a puff-ball. It is not necessary to know the species or even the genus to which a plant has been assigned in order to be able to make valuable suggestions to one's pupils. No man should accept the responsibility of teaching botany who does not know something of all the grand divisions of the vegetable kingdom, and who is not able to render a little aid to the pupil in whatsoever botanical class his plants may fall.—*Charles E. Bessey.*

The Entomophthoreæ.—According to a note in the *Journal of the Royal Microscopical Society*, Dr. E. Eidam has recently made a revision of the Entomophthoreæ (in Cohn's "Beit. zur Biol. der Pflanzen," IV., 1886), and given diagnoses of the genera,—seven in all,—viz., Empusa, Lamia, Entomophthora, Tarichium, Completoria, Conidiobolus, and Basidiobolus. He places the family in the Zygomycetes, in close proximity to the Mucorini, tracing a relationship to the latter through Piptocephalis and Syncephalis.

Laboratory Notes.—The usefulness of a simple and inexpensive *eye-piece micrometer* as a part of the outfit of each microscope in the laboratory can scarcely be fully appreciated until one has tried it. When the student has at hand at all times a means for making accurate measurements he will make many more records of measurements than when he has to call upon the demonstrator for a special eye-piece. A simple graduated disk of glass which rests upon the diaphragm of the eye-piece is sufficient. It is, of course, best to have it in a second eye-piece, but in case the microscope has but one eye-piece the disk can be easily removed when not needed.

Cheap, and still efficient, *culture-cells* for the growth of spores, pollen, etc., may be made by the use of the little vulcanite rings now sold by all opticians. A ring is fastened to a slide by means of gold size; when dry and firm a little oil is spread upon the ring, and upon this the cover-glass (bearing the hanging-drop, in which are the spores) is carefully laid, care being taken to secure an air-tight chamber.

Very frequently a student wishes *to preserve a specimen temporarily*, when he is obliged to leave the laboratory before completing his work. This he can do with most specimens by simply applying a drop of glycerin at the side of the cover-glass in such a manner as to effect a union between the water and the glycerin. The latter will slowly run under the cover-glass and preserve the moisture of the specimen often for many days.

The *value of dried specimens* of algæ, such as the Green Felts (*Vaucheriaceæ*), the *Œdogonieæ*, the Red Seaweeds (*Florideæ*), Rockweeds (*Fucaceæ*), etc., is probably not fully appreciated by demonstrators in laboratories. The structure of the plants of the groups just named, as well as of many others, can be made out very satisfactorily from dried specimens. One is able to take up types of the more important families of plants in their proper order, and during those parts of the year when they are not to be obtained from the water. In most cases the specimen must be moistened with alcohol and, after mounting, with potassic hydrate also. Some of the most satisfactory specimens I have ever seen have been obtained in this way. Of course, one must have good material to begin with.

An *instructive specimen* for the student of the lower plants may be obtained by making as thin sections as possible of the soft lichens of the genera *Collema*, *Leptogium*, or their allies. Any one who has previously studied the Nostocs will recognize them at once in the lichen sections, where they occur as "gonidia." One can, in fact, make use of lichens of this kind for supplying with certainty good and abundant specimens of Nostoc when the Protophytes are under consideration in the laboratory.

One of the most *instructive series of experiments* as to the water in the plant which the student can undertake consists of weighing green specimens of various kinds, and then, after careful drying, repeating the weighing to determine the loss of water. This can be done very satisfactorily in the winter, when the air of the laboratory is constantly dry, and when the steam-radiators can be utilized for drying the specimens. While the results are not absolutely accurate, they are sufficiently so to teach very forcibly the lesson that all plants contain a great deal of water, and that many of them are almost entirely water.

Botanical News.—A new monthly periodical,—*Popular Gardening*,—which first made its appearance last year, promises to become of interest to botanists as well as gardeners. It is published in Buffalo, N. Y.——Rev. Francis Wolle, of Bethlehem, Pa., well known as a student of the fresh-water algæ and author of a most useful work on the "Desmids of the United States," is preparing a treatise on the Fresh-Water Algæ of North America. The work may be expected about the middle of the year. It will be illustrated by one hundred and fifty plates, containing two thousand figures. We trust that the enterprising author will be rewarded by an abundance of orders for the book, which necessarily must be somewhat expensive.——In the February number of the *Journal of Botany* Richard Spruce describes a new Hepatic (*Lejeunea holtii*) from Ireland, and J. G. Baker a new fern (*Polypodium microchasmium*) from Jamaica.——A recent number of the *Gardeners' Chronicle* (February 12) contains a fine "ink-photo." of a group of British Guiana palms (*Maximiliana regia*).——The following are among the botanical books announced for early publication: An elementary class-book of botany, by Dr. Gray, "to take the place," according to the *Botanical Gazette*, "of 'How Plants Grow' and the 'Lessons';" an introduction to the study of lichens, by Henry Willey, of New Bedford, Mass.,—according to the *Torrey Bulletin*, "it will include the collecting and mounting of lichens, their structure and organs, the distribution of North American species, the history of lichens, with aids to their study;" a treatise on the fresh-water algæ of North America, by Rev. Francis Wolle, of Bethlehem, Pa.,—this work, of which mention has already been made, will be fully illustrated with colored plates; a treatise on the natural families of plants ("*Die natürlichen Pflanzenfamilien*"), by Professors Engler and Prantl, to be illustrated by many thousand wood-cuts to illustrate the structure; the anatomy and classification of the Hymenomycetes of Europe (*Les Hyménomycètes d'Europe*), by N. Patouillard.——Among recently-published botanical books are the following: "Lectures on the Physiology of Plants," by Dr. S. H. Vines; "Outlines of Classification and Special Morphology of Plants," by Dr. K. Goebel; "Grasses of North America," by Dr. W. J. Beal; "Microbes, Ferments, and Moulds," by E. L. Trouessart; the new edition of Rabenhorst's "Kryptogamen Flora;" vol. i. "Pilze," by Dr. Winter; vol. ii. "Die Fampflanzen," by Dr. Luerssen; vol. iv. "Die Laubmorse," by Limpricht (these are appearing in parts, each containing sixty-four pages).——Valuable exsiccati now publishing are: Ellis & Everhart's "North American Fungi"; Linhart's "Ungarus Pilze"; "Der Belgischen Muscineen," by Aigret and François; Wittrock and Nordstedt's "Algæ Aquæ Dulcis Exsiccatæ"; Krieger's "Fungi Saxonici Exsiccati"; Winter's "Fungi Europæi et Extraeuropæi Exsiccati."——Recent catalogues of botanical works which will prove valuable to botanical book-buyers are as follows: "A Catalogue of Botanical Works," by Dulan & Co., 37 Soho Square, London; "Bulletin Trimestriel des Sciences Naturelles" of Paul Klincksieck, 15 Rue de Sèores, Paris; "Katalog No. 202," von Heinrich Lesser, of Breslau; "Verzeidenis von Werken aus dem Gesamtgebeite des Botanik," von List & Frank, Leipzig; Koehler's "Katalog No. 448" (Floræ, Anatomia et Physiologia Plantarum, Phanerogamæ, etc.) and No. 449 (Cryptogamæ), Leipzig.

ENTOMOLOGY.[1]

On the Emergence of a Caddice-Fly from the Water.—On one occasion I had the good fortune to observe a caddice-fly leave the water and take its first flight. The specimen was an *Hydropsyche*, which I was breeding in an aquarium in my laboratory. It swam to the surface of the water repeatedly, using its long mesothoracic legs. When swimming, these legs were extended at right angles to the body like a pair of oars. The insect was unable to crawl up the vertical side of the aquarium, and after clinging to it for a short time it would lose its hold and sink back to the bottom. After watching it for a time I lifted it from the water by means of a stick. At this time its wings were in the form of pads, which were but little, if any, longer than the wing-pads of the pupa, as shown by the cast pupa-skin found floating on the water. The instant the creature was free from the water its wings expanded to their full size, and immediately it flew away several feet. In my efforts to catch the insect I found that it had perfect use of its wings, although they were so recently expanded. The time required for the insect to expand its wings and take its first flight was scarcely more than one second; it was certainly less than two. As these insects normally emerge from rapidly-flowing streams which dash over rocks, it is evident that if much time were required for the wings to become fit for use, as is the case with most other insects, the wave succeeding that which swept them from the water would sweep them back again and destroy them.—*J. H. Comstock.*

Destruction of the Codlin-Moth by Arsenical Poisons.—In the first of a series of bulletins to be published by the State

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

entomologist of Illinois Professor Forbes gives the results of a series of experiments made by him to test the efficiency of arsenical poisons in the protection of apples from the codlin-moth. From observations and experiments which he details, he estimates that about fifty per cent. of the possible apple crop is sacrificed to this insect. As the value of the apple crop of Illinois for the five years preceding 1884 is shown by the assessors' reports to have been about four and three-quarter million dollars, the value of the apples destroyed in an average year may be placed at this sum. A part of the apple crop reported, however, is doubtless obtained from neglected orchards, too badly damaged to repay especial attention; and in many cases, also, where the trees are heavily laden, the apples remaining uninjured after the codlin-moth has done its worst may amount to more than half the fullest crop permissible. Making for these and other modifying circumstances the liberal allowance of fifty per cent., Forbes estimates the loss due to the apple-worm in Illinois at one-half the value of the average crop, or two million three hundred and seventy-five thousand dollars. He then goes on to show that at least seven-tenths of this loss may be prevented by a single remedial measure so simple that any one may apply it, and without cost so far as its effect on the codlin-moth is concerned.

The insecticide employed was Paris green in water sprayed upon the trees with a force-pump. Three-fourths of an ounce by weight of Paris green, of a strength to contain 15.4 per cent. of metallic arsenic, was stirred up in two and a half gallons of water. White arsenic was also used, but was found not to be as efficient as Paris green; and the leaves on the trees which were sprayed with arsenic were scorched, while those to which Paris green was applied were entirely uninjured.

The time of year at which poisoning is most effective is in the spring, after the apples have begun to form, and while they are still upright. The poison lodges in the calyx, where, as is well known, the egg of the codlin-moth is laid. The young larva is thus poisoned as soon as it begins to eat its way into the apple. Later in the season, after the apples have begun to hang downwards, spraying will not deposit the poison where it will be reached by this insect. Moreover, it is dangerous to apply the poison late in the season, as it will lodge in the cavity about the stem of the apple, a position from which heavy wind and violent rain are not sufficient to remove it.

The results of his experiments are given by Forbes with considerable detail. They show that by spraying once or twice with Paris green in early spring, before the young apples had dropped upon their stems, about seventy-five per cent. of the apples exposed to injury by the codlin-moth were saved. The incidental benefit to the crop in the protection of the trees against foliage-eating insects, and also against the Apple Curculio, by thus spraying will fully compensate for the small expense of the Paris-green application. This expense, when the spraying is done on a large scale, with suitable apparatus, only once or twice a year must fall below an average of ten cents a tree.

On the Life-History of a Dipterous Parasite of the Silkworm.—In the new journal published by the Imperial University, Japan,[1] Professor Sasaki gives a very important paper on a dipterous parasite of the silkworm. Aside from the economic bearing of the paper, it is of interest to entomologists generally as giving a careful account of the habits of a parasitic insect which is peculiar in its mode of attack.

The so-called "Uji" disease, caused by the larva of a dipterous insect, *Ugimya sericaria*, plays terrible havoc among the silkworms reared in May and July. When the silkworm is once infested by this parasite it dies either before or after it spins a cocoon; in the latter case the maggot eats its way out of the cocoon, thus leaving a round hole in it, with the consequence of making it unfit for reeling. In the spring or May brood of silkworms some fifty to seventy per cent., or in extreme cases eighty per cent., are attacked by the parasite, and the damage done is correspondingly great.

Fatal as the "Uji" disease is to the silkworm, no systematic observations have hitherto been made on the habits and life-history of the maggot; but in this paper the insect is described in each of its stages, and considerable attention is given to anatomical features. We will notice, however, only that part which relates to the habits of the insect.

The adult flies generally begin to appear in April. From this time to the middle of June they frequent mulberry-bushes. The eggs are laid on the under surface of the leaves, in close contact with the ramified veins. The eggs are fastened to the leaves and enveloped with a transparent glutinous substance. Usually the eggs laid upon leaves in the month of May, if undisturbed, will remain alive during the month of June, but later they are destroyed by the severe heat of the sun. At the time when the deposition of the eggs takes place most abundantly the silkworm is in its third or fourth moult. The eggs are taken into the body of the silkworm at this time with its food. The small size of the egg and the hardness of the shell protect it from injury by the jaws of the insect.

In one to nine hours after the eggs are introduced into the digestive canal of the silkworm they hatch. The young larva measures 0.3 and 0.2 millimetre in length and breadth respectively. Its smaller anterior end is provided with a horny-hooked

[1] Journal of the College of Science, Imperial University, Japan, vol. i., Part I. Tokio, Japan, 1886.

jaw, while its broader posterior end has two spiracles, and each segment of the body is covered with a transverse row of setæ.

After remaining in the digestive canal from one to eight hours the larvæ pass out through the wall of the canal, and enter directly into the ganglia which lie close beneath the canal, generally leaving those ganglia free which are separated from the canal by the interposition of the silk-glands.

A single silkworm has usually one or two of its ganglia infested by the maggots, but sometimes more are found. In one case Sasaki found five ganglia thus infested by the parasite. Furthermore, a single ganglion may have more than one parasite in its interior. Nevertheless, usually but one reaches maturity. When the maggots once infest the ganglia the silkworm becomes generally weakened, and its body presents an unusual aspect from severe irritation of the nervous system. The segments are swollen out like the caterpillars of some hawk moths, and the disease is usually known by the silkworm-growers as *Fushidaka* or *Fushiko*,—swelled segment. Generally the maggot remains in a ganglion more than a week, and when it has become two to five millimetres long, or even larger in size, it gets free and passes into the body cavity of the silkworm. After travelling through the mass of fat which occupies the greater portion of this cavity it searches for the portions of the tracheal system of its host, where the stigmata open. On reaching one of these places it forces its way into the chamber directly inside the stigma, and forms a sort of a cup for the reception of its body by heaping up the fats and muscular fibres of its host round the opening made on entering, and sticking them together with its saliva. The mouth of this cup is directed towards the body cavity, while its bottom opens into the stigma of its host. The maggot, which rests in the newly-formed cup, projects its anterior end into the body cavity from the mouth of the cup, while its posterior end is directed towards the bottom of it. In this position the maggot anteriorly consumes fat as its food, and posteriorly respires the air which enters through the stigma. The cup which the maggot thus inhabits has a dark-brown color, partly produced by the action of the saliva upon the fats and muscles which build up the cup, and partially by the fæces which the maggot voids. When the cup thus colored is formed inside a stigma there appears a dark-brown or brownish-black patch around the stigma; so the presence of the patch is conclusive evidence of the fact that the silkworm is infested by its parasite. The similar marking which occurs on the body of a pupa enclosed in a cocoon is always due to the same cause. As the maggot grows in size the cup enlarges in proportion, and the maggot remains in this abode until it attains its full maturity, no matter whether the silkworm meanwhile turns into a pupa or not. The maggot usually leaves the cocoon of its host in the morning, especially of bright and hot days. Before changing to a pupa it usually crawls into the ground, getting down through some cracks or fissures in the floor of the house where it comes out. It descends to a depth of three or four inches before transforming. There is but a single generation in a year.

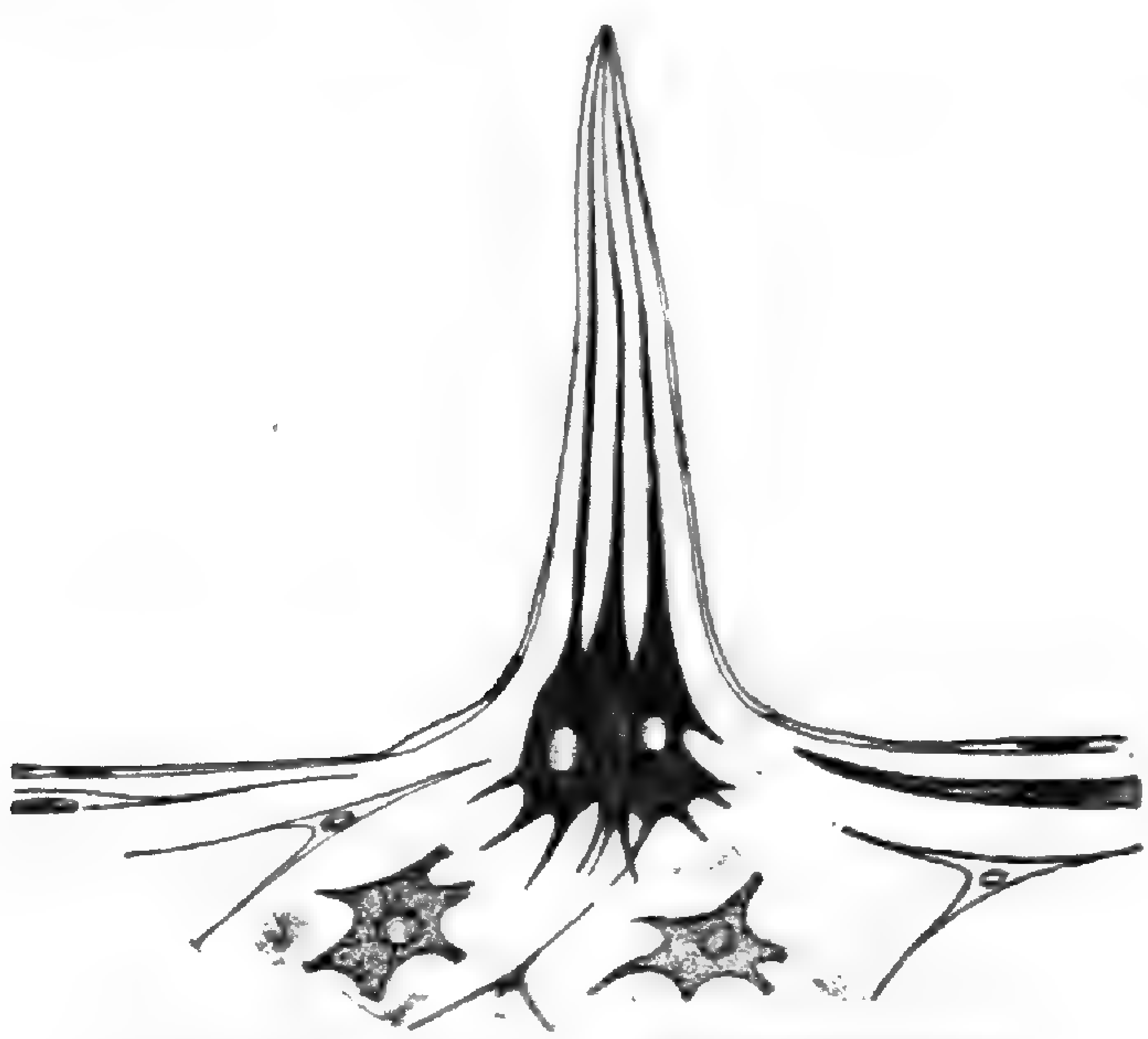
Entomological News.—The vine-growers of Algeria are now seriously troubled by the destruction caused by a Chrysomelid beetle, *Haltica ampelophaga.* In some places more than a third part of the whole production is destroyed by it. It feeds on grape-vine leaves only, eating them as fast as they appear, and ultimately killing the vine. As it is a very prolific insect, passing through at least five generations in a single summer, much is to be feared from it (*Science*, April 1).——Mr. George D. Hulst doubts the conclusion of Riley, that the dehiscent species of Yucca are fertilized only by the agency of *Pronuba yuccasella.* Mr. Hulst saw many honey-bees within the flowers before they closed in the forenoon, and only a small proportion of the capsules examined afterwards contained larvæ of Pronuba (*Entomologica Americana*, vol. ii. No. 12).——Miss Ormerod's "Tenth Report of Observations of Injurious Insects" has just appeared.

ZOOLOGY.

Artificial Parthenogenesis.—Two cases of parthenogenesis induced by artificial stimuli are of interest. The first is that recorded by Tichomiroff (*Archiv f. Anat. und Phys.*, 1886; *Phys. Abth. Suppl. Bd.*). He found, in the course of investigations instituted for another purpose, that the unfertilized eggs of the silkworm, under the influence of mechanical or chemical (strong sulphuric acid) stimuli, will develop. He concludes his short account with the following words: 1. "There can be no doubt that the eggs of *Bombyx mori* are capable of parthenogenetic development;" and, 2. "Such eggs which would not otherwise parthenogenetically develop may be induced to do so by stimuli." More interesting are the observations of Dr. J. Dewitz (*Biol. Centralblatt*, vii. p. 93). Normal parthenogenesis has been well authenticated in the case of the silkworms, but not in the Amphibia. Dr. Dewitz, with another purpose in view, placed some unfertilized frogs' eggs in a solution of corrosive sublimate, and, to his great astonishment, the next morning found them swollen and segmented. Some showed but one division, while others had divided several times. A few were irregular in their segmentation, but in the majority the normal order was followed. These facts were observed on the eggs of *Rana fusca*, *R. esculenta*, and *Hyla arborea*, and it was noticed that but a short immersion in the sublimate solution was sufficient to induce the segmentation.

Vitality of Encysted Forms.—Nussbaum, while studying the phenomena of digestion in Hydra, noticed that in the excrementa of the polyp there was a living embryo of Daphnia, the mother of which had just been eaten by the Hydra. The nettle-cells which killed the parent had not been able to affect the young. Led by this, Nussbaum killed pregnant female Daphniæ with absolute alcohol and observed that the embryos afterwards developed, proving that the cyst was a great protection. This immunity of the Daphnia embryo is, says Nussbaum, of great importance to the perpetuation of both the Hydras as well as of the Daphnia itself. With their voracious appetites, a few Hydras would rapidly depopulate a pool, and then would have to starve themselves were it not for the protection afforded the embryos by these resisting cysts. A similar instance is afforded by the seeds of many plants which, as is well known, pass uninjured through the alimentary tracts of many fruit-eating animals.

Sense-Organs of Sponges.—Von Lendenfeld describes, under the name synocils, some peculiar sense-organs in Grantia which had previously been described by Stewart as palpocils. From the surface project long conical processes, about 0.1 mm. in length, most numerous near the incurrent pores. These organs



Synocils of *Grantia ciliata*. After von Lendenfeld.

consist of prolongations of the mesodermal intercellular substance, and are apparently covered with a delicate epithelium. At the base are several oval nuclei, each surrounded with an irregular envelope of protoplasm, which sends out root-like processes, one of which runs to the tip of the synocil (see cut).

Von Lendenfeld suggests that the reason why these organs have escaped observation by all who have studied living sponges is that they are ordinarily retracted, and he recalls certain observations which he had previously made on the retracted sense-organs of other sponges. He hints at interesting comparisons of these with some of the peculiar sense-organs of the higher Metazoa, but without entering into any detail.

Organ of Smell in Crepidula.—The organ of smell, or osphradium, of gasteropod molluscs is a patch of sensory epithelium, which is placed in close relationship with the two normal gills with which these animals are provided. In many forms, however, one of these gills is aborted, and occasionally its place is taken by another branchial organ (*e.g.*, *Patella*), which has no relation to the typical branchiæ. In many forms there is also what is known as the rudimentary gill; but Spengel has shown that this is not respiratory in its function, but is rather a sensory organ, variously modified in its appearance. Dr. H. L. Osborn describes (*Zool. Anzeiger*, x. 118) this osphradium as it occurs in *Crepidula fornicata*. In this species the gill fills almost the entire mantle-cavity, but on the left of the gill-ridge is a low ridge of eighteen or twenty papillæ, each with a globular head and a short peduncle. This is the osphradium. The ridge from which the papillæ arise is traversed by a nerve sending branches into each papilla. In addition to this Dr. Osborn notices the existence of a peculiar high epithelium clothing the osphradial ridge, which differs from that on any other part of the mantle, and forms what appears to be a specialized organ. In this connection it may be mentioned that an investigation of the relations of osphradium to branchiæ in the limpet Acmæa would be productive of important results in settling the affinities of the family.

A Larval Galeodes.—The Arachnida of the sub-order Solifugæ are so little known that Croneberg's recent description of a larval stage of one (*Zool. Anzeiger*, No. 247, 1887) is worthy of mention. These animals are peculiar among arachnids in the possession of a segmented cephalo-thorax. Our native species have been studied by the late J. D. Putnam, whose posthumous account was published by the Davenport Academy of Sciences. Croneberg's account relates to *Galeodes* (or *Solpuga*) *araneoides* of the Transcaspian steppes. The young eggs had a diameter of 2 mm., while those ready to hatch measured 3.5 mm. Before hatching the abdomen is very large, while the cephalo-thorax (which is not represented as segmented in the figure) is thin, small, and quadrate. On hatching it appears as if the contents of the abdomen had been forced into the cephalo-thorax, as the former is now more ovoid, while the latter, as well as its appendages, are greatly distended. The cephalo-thorax and abdomen now show a weak segmentation, but the appendages as yet lack joints or tarsal claws. The hairy covering of the adult is lacking, there being only a double row of twelve bristles on the abdomen. There is no trace of abdominal feet at this stage, but they may have been present earlier. An embryonic wing-like process extends from the cephalothorax, on either side, between the third and fourth pairs of feet. No trace of it occurs in the adult. Its function is extremely problematical, and Croneberg only recalls similar organs in the embryos of Asellus.

Zoological News.—Protozoa.—R. S. Bergh has recently described two cases of division in the Dino-flagellates. (He employs this term for the old group of Cilio-flagellates, as the latter name is a misnomer; for, as was shown by Spengel in 1881, and by Klebs in 1883, independently there are no cilia in these forms.) The cases observed (*Zool. Jahrbuch*, ii.) were in *Ceratium tripos* and *Dinophycis acuta*. In each the process was essentially similar. For instance, in the former species the division took place across the body, one horn going with one half and the two curved horns with the other. Each half then proceeded to develop an envelope and the missing horn or horns.

Cœlenterates.—Under this term Von Lendenfeld gives (Spengel's *Zool. Jahrbuch*, ii.) a review of the fresh-water sponges and Cœlenterates of Australia, enumerating ten species in all. He describes a new sponge, *Tubella nigra*, and a new hydroid, *Cordylophora whiteleggei*. He also shows that the name *Hydra oligactes* Pallas (1766) has priority over *Hydra fusca* Linné (1789). In his remarks upon the fresh-water fauna of Australia he comments on the fact that not only in the Cœlenterates, but in the Protozoa, all the species are closely allied to marine forms.

Echinoderms.—P. H. Carpenter, in a note in *Nature*, says that the cysts on *Comatula rosea*, which he regarded as indicative of the existence of a British species of Myzostoma, prove not to be caused by those animals, but by a problematical organism resembling an egg in an early stage of segmentation, but in the poor state of the material at hand not capable of being carefully studied. Stains, in the hands of Dr. Graaf, yielded no nuclei.

Dr. Ludwig gives a paper on the Holothurians collected by the recent voyage of the Italian corvette "Pisani," around the world, and supplements it by descriptions of those collected by the Italian ship "Vedetta" in the Red Sea. These papers are in vol. ii. of the *Zool. Jahrbuch*. In vol. i. of the same publication, which has just come to hand, the same student has a review of the Echinoderm fauna of Bering Sea.

Worms.—Villot gives (*Ann. Sci. Nat.*, VII., i.) a supplementary revision of the hair-worms (Gordiaceæ), which changes somewhat his former paper of a dozen years ago (*Arch. Zool. Exp.*). He regards Leidy's *Gordius subspiralis* as being really *G. aquaticus*, while the species described by the American author under the latter name is something else. Leidy's *Gordius robustus* is probably *G. violaceus* Baird.

U. Drago describes (*Bull. Soc. Ent. Ital.*, xix., 1887) a new genus and species of Oligochæte worm (*Epithelphusa catanensis*), which occurs as a parasite on the gills of the Sicilian land-crab *Thelphusa fluviatilis*. It belongs to the family Enchytræidæ.

Kennel has a paper (*Zool. Jahrbuch*, ii.) on the land-leeches of tropical America, enumerating three species, of which *Cylicobdella coccinea* belongs to a genus before known from the same region, while *Lumbricobdella schæfferi* is a new genus, as well as a new species. The paper goes considerably into habits as well as structure, but contains no reference to Dr. Whitman's recent work on the land-leeches of Japan, already noticed in these columns.

R. von Lendenfeld notices (*Zool. Jahrbuch*, i.) the occurrence of *Tænia ecchinococcus* in Australia, and concludes, from the peculiarities of its distribution, etc., that the dingo, or native dog, is largely responsible for its dissemination.

CRUSTACEA.—At the meeting of the Linnæan Society of London a paper was read by Dr. P. P. C. Hoek, of Leiden, upon the rare barnacle *Dichelaspis pellucida* Darwin. The genus Dichelaspis is a genus of barnacles, allied to Lepas, of which several species are known. Some occur upon the bodies of various Crustacea, but this species is only known from the sea-snakes of the Indian Ocean. Darwin obtained his specimens from the scales of one of these Hydrophidæ, and since his description was published no other specimen has been recorded until the present one, which was likewise found attached to another of these snakes from the Mergui Archipelago.

Maurice Leger describes (*Ann. Sci. Nat.*, VII., i.) two cases of monstrosities in the spiny lobster (Palinurus). In one instance the antennula of one side is terminated by three flagella, while in the other the fourth left thoracic foot has three branches arising from the coxa, each with the normal number of joints. In cases like these it seems difficult to draw any important morphological conclusions, for in zoology teratology does not seem to have the value it has in botany. The paper is illustrated with a well-drawn plate.

Garpini has a paper on the anatomy of the Cypridinæ, illustrated by five plates, in the nineteenth volume of the "Bulletin of the Italian Entomological Society." The paper is chiefly descriptive, and enters but little into comparisons.

BIRDS.—The second English specimen of the Harlequin duck (*Cosmonetta histrionica*) was taken in Northumberland in December last. It is normally a member of the Arctic fauna, being circumpolar in its range.

Fishes.—Prof. C. Gilbert has an important paper on rare and little-known etheostomine Percidæ in the "Proceeds. of the U. S. National Museum." Several new species from Southwestern rivers are described.

Prof. A. Heilprin describes, in a very imperfect manner, a catfish which he supposes to be new, from Lake Okeechobee, Florida. It is a pity that Professor Heilprin did not, in his description, imitate some of the numerous good descriptions to be found in American ichthyological literature.

Dr. G. A. Boulenger has recently described some new species of fishes from the Congo.

Batrachia and Reptilia.—Dr. G. A. Boulenger has published, in the *Annals and Magazine of Natural History*, a list of the species from the department of Rio Grande do Sul of Brazil. He enumerates: Testudinata, 6; Crocodilia, 1; Lacertilia, 14; Ophidia, 42; Batrachia anura, 27; do. Urodela cæciliidæ, 1. Total, 63 Reptilia, 28 Batrachia.

Professor Cope describes, in the "Proceedings of the U. S. National Museum," a new species of water-snake, of the genus Tropidonotus, allied to the *T. woodhousei*, which he calls *T. bisectus*. It is only known from a specimen which was killed in the grounds of the armory, near the National Museum, in the city of Washington, D. C.

Dr. G. A. Boulenger has distinguished two species of the genus Bombinator in Europe. The *B. bombina* Linn. is yellow below, has closely-placed dermal tubercles, etc., and inhabits high ground. The *B. igneus* Linn. inhabits lower levels, and is black below, with large crimson splotches, and has the dermal tubercles sparse, etc.

EMBRYOLOGY.[1]

The Embryology of the Monotremata and Marsupialia.—In *Nature* for March 31, 1887, the following abstract is given of the first part of a memoir by W. H. Caldwell, with the above title, which was presented at the meeting of the Royal Society held on March 17 last. Deeming the subject one of unusual interest, the author's abstract is here given in full:

"(1) *The Egg-Membranes.*—In Monotremata, in very young ova, a fine membrane exists between the single row of follicular cells and the substance of the ovum. This membrane, which I will call *the vitelline membrane*, at first increases in thickness with the growth of the ovum, and through it pass numerous fine protoplasmic processes connecting the protoplasm of the follicular cells with that of the ovum, and serving to conduct food-granules, which, appearing in the neighborhood of the nuclei of the cells,

[1] Edited by Prof. John A. Ryder, Biological Department, University of Pennsylvania, Philadelphia.

travel thence to the ovum; food-granules also appear in the neighborhood of the germinal vesicle, and travel away from it; hence the horseshoe-shape of the yelk-mass as seen in section.

"The time during which food-granules are thus passing from the follicular cells to the ovum may be called 'the yelk-forming period.'

"It is succeeded by a period during which the vitelline membrane again becomes thin, the follicular cells are reduced to a single layer, and the cells are very thin and flat. This period may be called 'the absorption-of-fluid period,' since during it the ovum absorbs large quantities of fluid through the thin vitelline membrane and single layer of thin follicular cells, and thereby increases largely in size.

"This is in turn succeeded by a third period, during which the follicular cells again become active, multiply, increase greatly in size, and give rise, between themselves and the vitelline membrane, to a deeply-staining homogeneous layer, which I will call the *chorion*. This period may be called 'the chorion-forming period.' All these three periods are gone through while the ovum is still in the follicle.

"Upon the bursting of the follicle and the reception of the ovum in the Fallopian tube, a few of the follicular cells remain attached to the chorion; the majority are left behind within the burst follicle.

"During the passage along the Fallopian tube the vitelline membrane again increases in thickness, and the chorion, also increasing in thickness, absorbs fluid and becomes *the albumen layer*. Outside this now appears a new structure, *the shell* or shell-membrane, of tough, parchment-like consistency,[1] not staining with reagents. I have not yet traced the deposition of the shell to the activity of any special glands; but I can say that the shell-membrane does not increase at the expense of the chorion or albumen layer.

"After reaching the uterus both vitelline membrane and shell-membrane increase in thickness, but the albumen diminishes and disappears, serving, apparently, for the nutrition of the ovum. Immediately beneath the vitelline membrane a new layer is now seen in hardened preparations; but it may be shown that this layer is really fluid, yielding a coagulum which stains deeply with reagents, the fluid being apparently derived, through the membranes, from the uterine glands.

"In Marsupialia the history of the vitelline membrane, save that 'the yelk-forming period' is not marked off from the 'absorption-of-fluid' period, is similar to that in Monotremata. I have not been able to trace the beginning of the 'chorion' while the ovum is still in the ovary in Marsupialia; but in an ovum of

[1] "In the laid egg of Echidna I have not detected calcic salts, but that of Ornithorhynchus gives rise to gas when treated with dilute acid."

Phascolarctos from the uterus I found a chorion like that of Monotremata, and surrounded, moreover, by a thin, transparent membrane,—a *shell-membrane.* Within the uterus the chorion, increasing in thickness, becomes transformed into an albumen layer, and is eventually absorbed, passing through the vitelline membrane to nourish the ovum, so that eventually the vitelline membrane comes to be close to the shell.

"As in Monotremata, a coagulable, and, when coagulated, deeply-staining fluid makes its appearance between the vitelline membrane and ovum (blastoderm).

"The shell-membrane persists until the developing ovum becomes fixed to the walls of the uterus, after which it disappears."

The paper then compares the egg-membranes just described with those of Placentalia and those of Vertebrata generally.

"(2) *Segmentation.*—The telolecithal ova of Monotremata and Marsupialia go through a partial segmentation. The ova of Placentalia segment completely, but the resulting blastodermic vesicle is identical with that produced by partial segmentation in Monotremata and Marsupialia.

"*In Monotremata* there is a posterior lip to the blastopore similar to that of Elasmobranchii. The epiblast grows in so rapidly from the sides that a primitive-streak region is formed in front of the posterior lip long before the epiblast has enclosed the yelk. This unenclosed area in front of the primitive streak probably includes a region where the hypoblast (yelk) has secondarily broken through the epiblast. The existence of such a region would hide the position of the anterior lip of the blastopore. The circumference of the circle made up by the larger arc of the edge of the blastoderm on the yelk, and the smaller arc of the posterior lip of the blastopore, is a measure of the quantity of yelk in a meroblastic ovum.

"*In Marsupialia* the epiblastic growth encloses the hypoblast at a very early age, except over a very narrow slit in front of the posterior lip of the blastopore. This slit corresponds to the area enclosed by the circle described above in a meroblastic egg. The primitive streak is not conspicuous at an early age because of the large size of the cells. No hypoblast projects through the epiblast in front of the primitive-streak region. I would explain the segmentation and the gastrula of Placentalia in the same way. Balfour's objection ('Comp. Embryol.,' vol. ii. p. 187) to Van Beneden's original comparison of the blastopore of the rabbit with that of a frog is explained away by the presence of a posterior lip to the blastopore in Marsupialia. My explanation postulates the existence of a similar structure in the rabbit. The blastopore of the rabbit corresponds, therefore, to the whole area marked out by the growing epiblast and the posterior lip of the blastopore, before the closing of the primitive-streak region, or to this area minus the secondary extension, caused by the projecting yelk in the Monotremata."

[Selenka, in his recently-published memoir[1] on the development of the opossum (*Didelphys virginiana*), has shown that there remains but little doubt respecting the homology of Van Beneden's blastopore with the blastopores of Marsipobranchii, Amphibia, Elasmobranchs, Aves, and Reptilia. It is also interesting to note that he does not find that any part of the ectoblast is converted, in the blastodermic vesicle of the opossum, into the transitory *Reichert'sche Deckschicht*, as in the blastodermic vesicles of Rodentia generally. He also shows that the segmentation is very distinctly meroblastic at first, and therefore unlike that of the ova of Placentalia, and that the blastosphere finally includes more or less non-nucleated yelk-material, while the peripheral epiblast, at certain points on the blastodermic vesicle, becomes thickened and efficient in taking up the albumen which lies between the inner face of the zona pellucida and the external zona or granulosa-membrane.—ED.]

SCIENTIFIC NEWS.

—The British Association for the Advancement of Science will hold its fifty-seventh meeting at Manchester the week commencing Wednesday, August 31, 1887, under the presidency of the eminent chemist, Sir Henry E. Roscoe. The local committee is very desirous of giving to this meeting an international character, and to this end have sent invitations to large numbers of scientific gentlemen both on the continent and in America. It is desirable that all intending to be present should inform the local committee (38 Barton Arcade, Manchester, England) at an early date, so that the necessary arrangements may be made.

—The American Association for the Advancement of Science will meet this year in New York City. The meeting will begin August 10 and continue one week. This is the first time that a meeting has been held in New York, and a large attendance is expected. Arrangements have been made by which the various sessions will be held in the buildings of Columbia College. The retiring president, Professor E. S. Morse, of Salem, Mass., gives the presidential address, and the meeting will be presided over by the incoming president, Professor S. P. Langley, of Alleghany City, Pa. A local committee will be appointed, which will make

[1] Studien über Entwickelungsgeschichte der Thiere. 4tes Heft, 4to. Wiesbaden, 1886.

all needed arrangements, due announcements of which will be made. The permanent secretary is Professor F. W. Putnam, of Salem, Mass. The attention of members is called to the new regulations regarding communications to be read at the meeting, and which resulted in the publication of the Proceedings of the Buffalo meeting more promptly than in any recent year.

—The next annual meeting of the American Society of Microscopists will be held in Pittsburg, Pa., commencing August 30, 1887. The president, Professor William A. Rogers, of Waterville College, Waterville, Me., or the secretary, Dr. D. S. Kellicott, 119 Fourteenth Street, Buffalo, N. Y., will furnish all desired information concerning the society or the meeting to any one who may apply to them.

—Entomologists will be pleased to learn that Mr. Samuel H. Scudder's "Butterflies of New England," a work proposed many years ago, is rapidly approaching completion. It will be, as far as possible, exhaustive, and will be illustrated by from seventy to a hundred plates, besides several hundred cuts in the text.

—It is the present intention of the United States Fish Commission to send the steamer "Albatross" to the Pacific shores next year to conduct there investigations similar to those which have been carried on for the past fifteen years along the Atlantic coast of the United States. The Commission is now engaged in preparing, in connection with the Signal Service and Light-House Board, temperature charts of the Atlantic from Maine to Florida. These are to have isothermals of ten days' means, and it is hoped that they will throw considerable light upon the migrations of the more important of the economic fishes.

—The second edition of the late Professor Balfour's "Treatise on Comparative Embryology" is announced by the publishers as a "reprint without alteration" of the first edition. An examination, however, reveals a very serious alteration, in that the pages of the new edition are not the same as those of the old, a matter of considerable importance when one wishes to refer to some statement. For this alteration there is no excuse.

—The botanical collections of the late Thomas Moore have been acquired by the Royal Herbarium at Kew. They are especially rich in ferns.

—Among the recent deaths of scientific people we notice those of Professor Vincenzio Tenore, the botanist, at Naples; Dr. Cornelius Marinus van der Sande Lacoste, the student of mosses, at Amsterdam, January 15, at the age of seventy-two; Dr. A. Pokorny, the botanist of Vienna, at Innspruck, December 29, 1886, at the age of sixty-one; Dr. August Wilhelm Eichler, Professor of Botany at Berlin and author of the "Flora Braziliensis," March 2, at the age of forty-eight; Dr. G. Kirchenpaur, of Hamburg, the author of several works on zoophytes, March 8; Valère Liénard, anatomist and assistant to Felix Plateau, at Brussels, August 20, 1886, aged thirty-one; Dr. Eduard Becher, entomologist, at Vienna, November 11, 1886; Dr. J. E. Schödler, anatomist and student of the Entomostraca, at Berlin, November 19, 1886; Jules Lichtenstein, entomologist and student of the aphides, at Montpellier, France, November 30, 1886, aged sixty-eight; Adolf Werneburg, student of Lepidoptera, at Erfurt, January 21; Professor C. W. Hering, student of Lepidoptera, at Stettin, February 1, aged eighty-five.

—With the present volume (the third) of *Entomologica Americana* Mr. John B. Smith resigns the editorship, his place being taken by the Rev. George D. Hulst, of Brooklyn, N. Y.

—Harper & Bros. announce for early publication an edition of Charnay's "Ancient Cities of the New World," translated from the French by J. Gonino and Helen S. Conant. The work deals with Charnay's explorations in Central America, under the patronage of the Lorillards.

—At the sale of the library of the late A. T. Stewart, Audobon's "Birds" brought thirteen hundred and fifty dollars, and Catlin's "North American Indian Portfolio" forty dollars.

—Mr. S. E. Cassino, of Boston, will publish early in 1888 a new edition of his "Directory," which will give the names and addresses of the scientists of the world. The same house also announces for early publication Strasburger's "Botanische Practicum," translated by Rev. A. B. Hervey.

—Baron Eggers is to conduct a series of botanical explorations during the coming year in the higher mountains of San Domingo, the flora of which is almost entirely unknown.

—The Royal Society is to introduce a new feature in the "Philosophical Transactions" the present year. They will in the future be published in two parts,—one containing papers relating to the mathematical, the other to the natural, sciences.

—Dr. C. Gottsche has been elected custodian of the mineralogical collections of the Natural History Museum at Hamburg.

—The new university building at Upsala will be dedicated with appropriate ceremonies May 18. The king of Sweden will be present, and representatives are expected from many European universities. The building was begun in 1879, and is the finest structure devoted to higher education in Europe.

—Engelmann, the well-known publisher of Leipzig, announces a large work on the "Natural Families of Plants," edited by Professors A. Engler, of Breslau, and Karl Prantl, of Aschaffenburg.

The collaborators will be numerous, embracing such well-known names as Cohn, Eichler, Luerssen, Pfitzer, etc., thus insuring a thoroughly reliable work. It is estimated that the whole work will make some five thousand pages, illustrated with several thousand wood-cuts. It will be published in parts of forty-eight pages each, at a subscription price of a mark and a half each.

—Dr. Brown-Séquard, of Paris, has been elected President of the French Zoological Society, in the place of the late Paul Bert.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—April 6, 1887.—Dr. Edward G. Gardiner spoke of the development and homologies of hoofs, claws, and nails, discussing his own studies as well as those of Dr. Boas, of Copenhagen. Mr. Samuel H. Scudder read the results of his studies of fossil butterflies. Fossil butterflies, he said, are very rare. About thirty thousand specimens of fossil insects are now in collections, the celebrated beds at Florissant, Colorado, furnishing about half of these. Of this large number only sixteen are butterflies, nine of these being from the European tertiaries and seven from Florissant. These sixteen belonged to three existing families, the American species all being members of the Nymphalidæ, while the European were divided among this family and the Hesperidæ and Papilionidæ. The European species showed many resemblances to the forms found in the East Indies and sub-tropical America to-day, while the American specimens were more American in relationship. One, however (a member of the Libythæinæ), found its nearest living relative on the coast of West Africa. One specimen of these insects was remarkably well preserved. Not only did it show the structure of antennæ, palpi, legs, and wing-nervures, but it was possible to detect the pattern of the color-markings, and even to draw some of the scales on the wings. Suggestions as to the possible food-plants, based on the present habits as well as on contemporaneous flora, were given.

Middlesex [Mass.] Institute.—April 13, 1887.—The paper of the meeting was upon a trip to Alaska by William Chase. It was illustrated by lantern-views, and detailed, among other things, the appearance of the Muir Glacier, of Glacier Bay.

Brooklyn Entomological Society.—March 1, 1887.—Mr. A. C. Weeks described the life-history of the moth *Tarache* *delecta.* The striped larva, which somewhat resembles that of *Alypia octomaculata*, feeds upon the leaves of *Hibiscus moscheutos.* Mr. Weeks also spoke of the effect of the weather upon the time of emergence of imagines from the pupal state.

Entomological Society of Washington.—March 3, 1887.—Mr. J. D. Sherman, Jr., gave a record of insects observed in 1886 near Peekskill, N. Y. Mr. J. B. Smith called attention to the fact that the antennæ of *Cressonia juglandis* resembled that of the Saturnians in its double pectinations, and that two species have hitherto been confounded under the name of *Euerythura phasma.* He also said that he regarded most of the so-called varieties of *Callimorpha lecontei* as entitled to specific rank, basing his opinion upon the large series in the museum. Dr. E. A. Schwartz enumerated eighteen species of Scolytidæ occurring on *Pinus inops*, and exhibited and described the galleries made by *Pityophthorus pullus.* The central chamber is rather large and oval, and from it radiate from three to five long and undulating galleries. The larval galleries are greatly curved.

Philadelphia Academy of Natural Sciences.—August 17, 1886.—A letter was read from E. H. Thompson, United States Consul at Merida, Yucatan. The writer stated, with reference to the account of fatality from scorpion-bites in Durango, that in no case does death result from such a cause in Yucatan. Tingling and numbness result, and are relieved by strong ammonia. Miss A. M. Fields, in a letter from Swatow, China, stated that *Bombyx mori* can be readily raised on lettuce, but in that case yields coarser silk. Silk-glands taken from the larvæ of several species of large moths just before entering the pupa stage are used for fishing-lines. Mr. Woolman presented a specimen of erythrite from French Creek, Pa. The mineral is rare in the State.

August 24.—Mr. Meehan read a paper on the agency of insects in plant-fertilization. He held that the dependence of a plant on insect aid is rather an evidence that its race is nearly run. The long, black anthers of *Cassia marilandica* never seem to shed their pollen unless the membrane at the apex is broken by humblebees, who pierce it to get at the contents. A plant covered with gauze neither shed pollen nor produced seed.

September 14.—Miss H. C. DeS. Abbott read a paper on Saponine, a compound which is always a constructive and formative element of the plant containing it, and one which, by its action on other elements, probably aids in nutrition. It is absent when the floral elements are simple, and increases in quantity as they are of higher grade. Chemical constituents are evolved *pari passu* with the evolution of the plant, and are a fit basis for botanical classification. Miss Abbott also called attention to two new substances obtained by her from a Honduras plant, and to chichipatin, a new dye. The Rev. Dr. McCook called attention to the longevity of some arthropods. He had kept a tarantula alive since 1882. The queen of Sir J. Lubbock's colony of ants was seven years old in 1882. Dr. Leidy remarked that Muybridge's photographs of lions in motion distinctly showed spots, though none could be detected by the eye.

September 27.—Miss Fielde sent a communication relative to the spiritist practices of Chinese women.

October 5.—Prof. H. C. Lewis read a paper upon the results of his last two years' geological work in Europe. Glacial action was essentially identical on both sides of the Atlantic. The ice-sheet which once covered the greater part of Ireland was composed of confluent glaciers, while distinct local glaciers occurred in non-glaciated areas. There seem to have been five centres of glaciation. No evidence of any great marine submergence was discovered. Ice coming from Scotland across the North Channel seems to have joined the Irish sheet, and a mass of ice filled the Irish Sea, overriding the Isle of Man and Anglesea. Wales had three distinct systems of glaciers. The finest exhibition of a terminal moraine in England is at Ellesmere, Shropshire. Professor Lewis enunciated the principle that whenever marine shells occurred in glacial deposits at high levels it was not owing to submergence of the land, but to the advance of the ice out of the sea on to the land. He also believed that there had been but one advance of the ice. Probably the land had been elevated some five hundred feet, with a fall of temperature of about 10° Fahr. Professor Heilprin exhibited a series of fossil shells of the genus Fulgur, showing the derivation of the forms from each other. Miss L. E. Holman told of a new mode of multiplication of amœbæ. A smaller one was enveloped by a larger and afterwards released; it then threw out spores.

October 17.—Professor Heilprin called attention to the discovery, in the Miocene beds of Tampa, Fla., of three species of Partula, a genus now confined to a small group of Polynesian islands. The probability of a former connection between the Atlantic and Pacific was spoken of. A fossil cowry from Florida was distinguished from all known forms by the presence of a sulcus from the mouth around the apex.

October 24.—Mr. Meehan gave some facts of local plant distribution. In one case, under the shelter of a blackberry-bush in a cleared spot in a wood, twenty-two species not found in other parts of the wood had sprung up. Professor Ryder exhibited a curious fish, related to Gastrostomus, dredged by the "Albatross" in fifteen hundred and nine fathoms. Professor Scott presented a paper on Mesonyx and Pachyæna.

November 2.—Professor Ryder spoke concerning the last experiments in oyster culture carried on by the United States government. Mr. Meehan gave reasons for the belief that cold alone would not account for the effect produced on plants at the close of the year.

November 9.—Prof. J. A. Ryder called attention to the fact that the oil-drops in the eggs of *Macropus venustus* are one-seventh of the whole mass, and they will float until the oil is separated. The buoyancy of the ova of the cod is not caused by the oil-drops in them. Dr. Kœnig described a silicate allied to black garnet, but with eight per cent. of titanic oxide. Dr. Dolley stated that the organ in Porpita supposed by Conn and Beyer to be a sense-organ was, in truth, a mucous gland furnishing a plentiful secretion to the tentacles. Mr. Ford exhibited specimens to prove the increase of size of *Arca pexata* as it goes north and east.

November 16.—Professor Heilprin described some miocene shells from Cumberland County, N. J. The specimens established the fact that these New Jersey beds belong to the lowest miocene. The same speaker showed a curious gastropod, which has a two-story shell, a dome being secreted by the mantle above the true spine. Dr. Kœnig stated that "schorlemite" was simply a modification of garnet. Professor Ryder described the extrusion of the polar globules from fish-ova. A paper, "On an Undescribed Meteorite from West Tennessee," was presented from Dr. F. A. Genth.

November 23.—Dr. Dolley called attention to the action of fibres of spider-web in starting lateral branches of stalactites. Professor Ryder gave the results of his investigation of the hepatic tubules of Oniscus. Professor Kœnig placed on record the occurrence of a manganese-zinc serpentine at Franklin, N. J.

November 30.—Miss H. C. DeS. Abbott announced the discovery of Hæmatoxylin, or logwood dye, in *Sarica indica.* In the bark it is more plentiful than in the logwood of commerce. Professor Ryder said he was in possession of facts which proved that pathological changes might be transmitted and become morphological.

December 21.—Professor Heilprin described a new Aplysia from the west coast of Florida. The presentation to the Academy of the collection of land-shells made by the late Mr. Brown, of Princeton, was announced.

January 8, 1887.—Professor Ryder described certain funnel-shaped ducts on the catfish, just behind the head. They are urinary in function. A curious core, exactly fitting what seemed a bore-hole, was by Dr. Kœnig announced to be a natural product, and to consist of molybdenite. Mr. Meehan exhibited a form of fungus (*Cordiceps taylori*) which is found on the heads of Australian caterpillars. Professor Heilprin described a new Ictalurus from Lake Okeechobee, Fla.

January 22.—Dr. Fetterolf presented a slab of Mauch Chunk red shale from the base of the Carboniferous. It had a fine amphibian foot-print, stated by Professor Heilprin to be certainly that of an animal generically distinct from that characterized by the late Dr. Lea. Professor Ryder called attention to certain cells immediately surrounding the yelk of fish-ova. These take a deep color on staining, and in fishes of the shark and ray tribes have been seen to be sucked up by the heart of the embryo and thrown into the circulation. Dr. H. H. Rusby gave an account of his exploration of the coca region of Bolivia. His collection included two hundred and fifty to three hundred kinds of unknown drugs. A paper on "New Generic Forms of Cretaceous Mollusca," by Dr. C. A. White, was presented.

January 25, 1887.—Professor Ryder called attention to the existence of pathological growths in the lower animals, and described a lobulated tumor from the heart of an oyster, a mass of organic tissue formed in the fore part of a shad's alimentary canal, and the degeneration of the Wolffian bodies of a goldfish. A letter from Miss A. M. Fielde, describing the geology of Southeastern China, and accompanied by specimens of the rocks, was read. Granite, trap, and unfossiliferous red sandstone were among the rocks. Miss Fielde also announced the collection, around Swatow, of several forms of rhizopods identical with those described by Dr. Leidy from Philadelphia. Dr. McCook stated that *Formica fusca*, the ant enslaved by *F. sanguinea* and *Polyergus lucidus*, builds, when exposed to the attacks of the latter, a formicary, which is quite flat and has all its entrances concealed by grass and chips of bark. When the same species deems itself secure it forms a mound, over which openings are scattered without attempt at concealment.

National Academy of Sciences.—The following papers were read at the meeting commencing April 19, 1887: "On Chemical Integration," by T. Sterry Hunt; "Results of the Investigation of the Charleston Earthquake," by C. E. Dutton and Everett Hayden; "On some Phenomena of Binocular Vision," by Joseph LeConte; "The Vegetation of the Hot Springs of the Yellowstone Park," by W. G. Farlow; "On the Fore Limb and Shoulder-Girdle of Eryops, and on the Vertebrates of the Triassic," by E. D. Cope; "On the Rainless Character of the Sahara," by Elias Loomis; "The Color of the Sun," by S. P. Langley; "A New Map of the Spectrum," by S. P. Langley; "Chemical Constitution and Taste," by Ira Remsen; "On a New Class of Compounds analogous to the Phthaleins," by Ira Remsen; "On the Decomposition of Diazo-compounds by Alcohol," by Ira Remsen; "On the Ancestry of the Deaf," by A. G. Bell; "On the Notation of Kinship," by A. G. Bell; "On the Determination of Orbits of Planets and Comets," by J. W. Gibbs; "On the Serpentine of Syracuse, New York," by G. H. Williams; "On the Barometric Oscillation—Diurnal and Annual," by A. W. Greely;

"On the Floridian Geology," by W. H. Dall; "On the Taconic System of Emmons," by C. D. Walcott; "Is there a Huronian Group?" by R. D. Irving; "On the Brain of Ceratodus, with Remarks on the General Morphology of the Vertebrate Brain," by B. G. Wilder; "Outline of the Ichthyological System," by Theodore Gill.

The following new members were elected: Prof. H. P. Bowditch, Boston; Prof. George H. Cook, New Brunswick; Prof. T. C. Mendenhall, Terre Haute.

Dr. A. W. Hoffmann, Berlin, was elected foreign correspondent.

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ARAUJIA ALBENS AS A MOTH-TRAP.

BY ROBERT E. C. STEARNS.[1]

THE plant which I have to notice because of its peculiarity as an insect-trap, rather than on account of its botanical aspect or relations, is referred by botanists to the order Asclepiadaceæ. This order includes the so-called Milk-Weeds, as well as a great number of other curious, interesting, and economically important forms.

The species under consideration—formerly *Physianthus*, now *Araujia albens*—is a native of Buenos Ayres; it has been pretty widely distributed. Its rapid growth, hardy habit, and clean, shining leaves have made it a favorite for ornamental purposes where an attractive, quickly-spreading vine is desired. It has been introduced into this country, to the East and North, in the vicinity of Boston, in Massachusetts, and as far west as the neighborhood of San Francisco, in California. It appears to thrive equally well in these widely remote regions.

In November, 1880, I noticed, one day, three or four moths fluttering in rather a peculiar way upon or around the blossoms of a large *Araujia* vine that covered one side of the porch of my house, in Berkeley, California. I found, upon closer examination, that they were fastened to the flowers, and, upon still more careful scrutiny, that the proboscis was, in each case, submerged in the flower, and the end of it hidden in the interior of the blossom. Besides the living moths, there were several dead ones

[1] Read before the Biological Society, Washington, D. C., February 19, 1887.

attached to other blossoms. Knowing that many of the plants of the family to which *Araujia* belongs are poisonous, my first thought was that the moths attached to the blossoms, living and dead, were intoxicated or had been poisoned by some peculiar property of the nectar.

Physianthus, or *Araujia*, as a moth-trap had long before been observed and made known, though I was not aware of it. The matter, however, was new to me, and the investigation full of interest, and an ample reward for the trouble. My curiosity was again revived the following year, upon what may be called the recurrence of the late moth season; and further investigations followed it.

My note-book about this time reads: "Saturday, November 5, 1881, detected the first entrapped moths of the (second) season, *nine* in number; some dead, others apparently just caught. Sunday, November 6, eight or nine more; some just alive, others just caught. This morning (Monday, November 7), five more. Tuesday, November 8, a windy and cold day, two. Wednesday, November 9, windy and cold, two;" and so on.

The trapping seasons—for there appear to be *two*—occur in August and November. It may be that there are *two* flights of the principal species of moths that frequent these flowers,—one, the first in early autumn, with apparently a gap; then again, the second and last flight, as indicated, later in the year.

My note-book shows that in the summer of 1883 the first flowers on my *Araujia* vine opened about August 19, and the first trapping of the season—a *bee*—occurred on the following 24th day of said month. August 25, a moth; the 26th, two moths, etc.

The plant continues to bloom for some time after the flights of the moths have ceased, though the number of the flowers gradually decreases with the closing of the autumnal season.

On turning to the figure of the flower it will be noticed that it is trumpet-shaped, flaring at the mouth, where the petals divide, then uniting and forming a tube, which is swollen into a bulbous form where the corolla joins the calyx. Now, this enclosing tube being pulled off, we are able to see the stamens with the side wing-like processes and the exterior spurs pressing against the gymnecium and hiding the ovaries and pollen-masses, as heretofore represented in the figures. The moth, in pursuit of

FIG. 1.

the nectar, first reaches that portion contained in the pockets between the bases of the spurs; then in search of more, having already thrust the proboscis down the tube of the flower, describing a curve between the exterior of the stamineal crown or mass and the inside of the bulb of the perigonium, it then has to push the proboscis upward in order to reach that portion of the flower where the anther-cells, pollen-masses, and glands are in close juxtaposition. Having satisfied its hunger, or otherwise, upon attempting to withdraw the proboscis, as the moth can only make a direct pull, it (the proboscis) not being provided with any muscular arrangement by which the curved motion made in entering, as just described, can be reversed,—to repeat: upon attempting to withdraw its proboscis, *by a direct pull,* it becomes wedged in between the edges of what may be termed the anther-wings, or, rather, the edges thereof, and is held tight, very much in the same way that an old-fashioned boot-jack grips a boot. The more the moth pulls, the tighter or firmer the grip, and escape is impossible, unless the flower has reached such a degree of maturity that its substance has become somewhat softened or wilted.

DESCRIPTION OF FIGURES.

In Fig. 1 we have a spray of *Physianthus,* or *Araujia,* which gives an idea of the general form of the plant, its leaves and flowers.

FIG. 2.

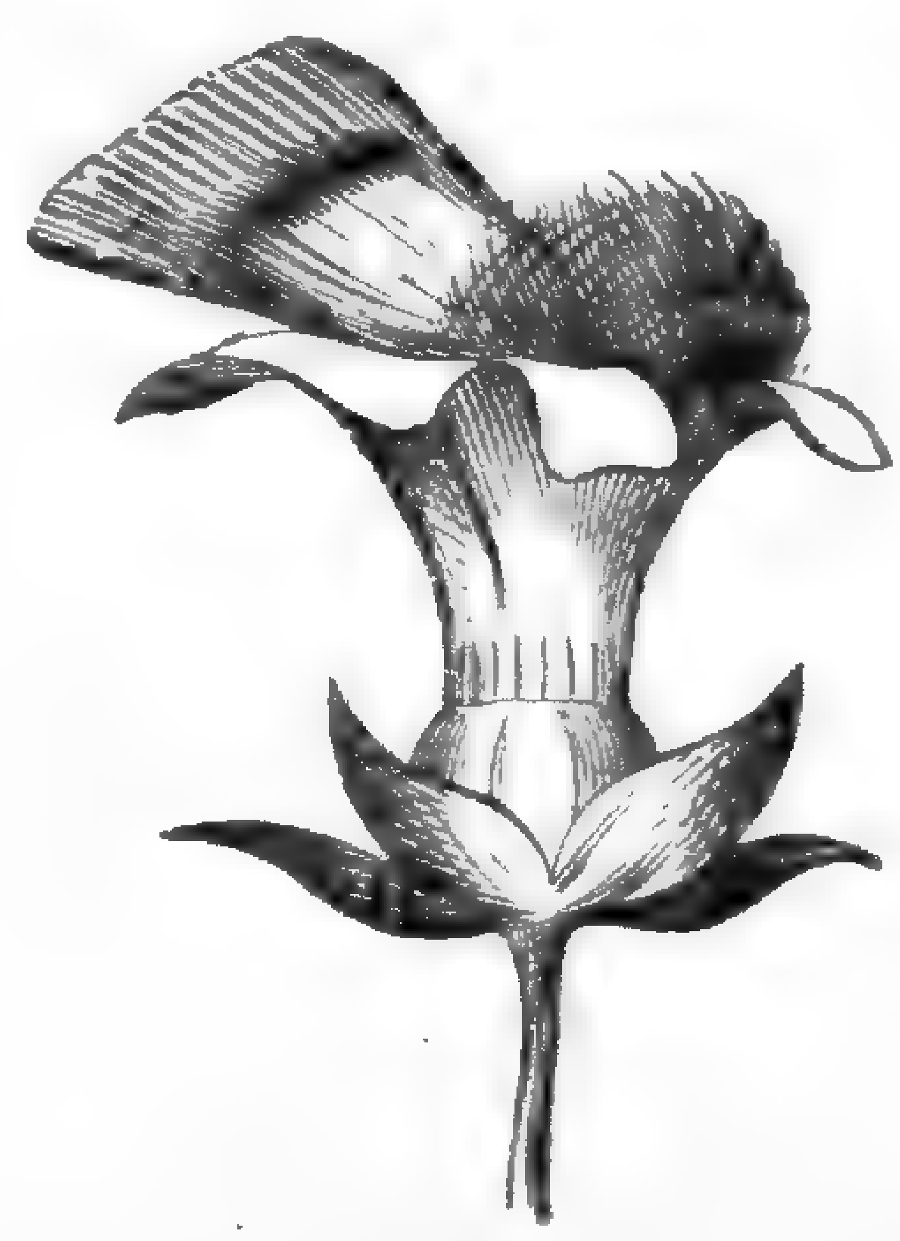


FIG. 3.

In Figs. 2 and 3, a flower, each with a moth upon it, showing a back- and side-view of the insect in repose.

FIG. 4.

In Fig. 4, the perianthum or perigonium, constituting a single flower or blossom.

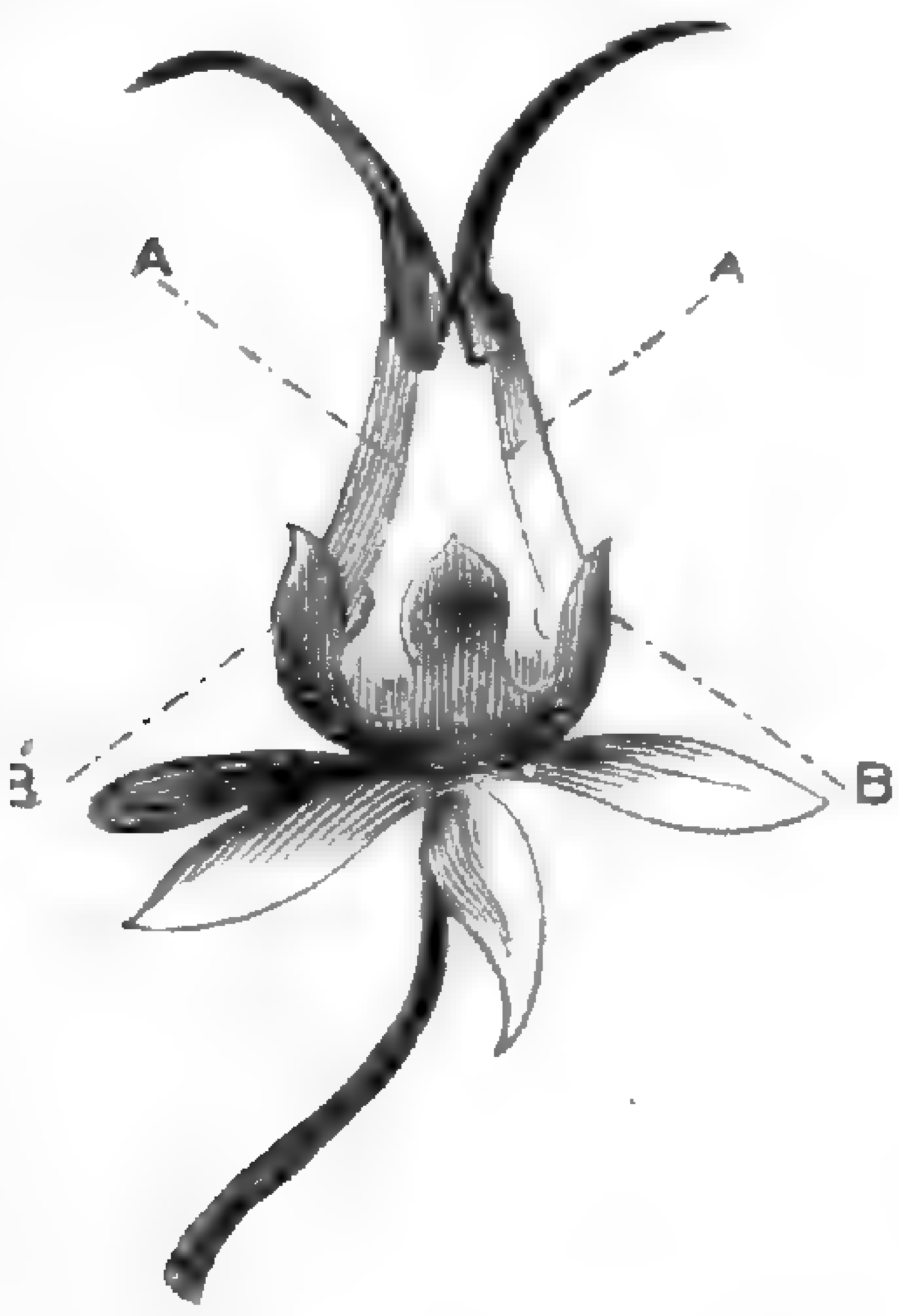


FIG. 5.

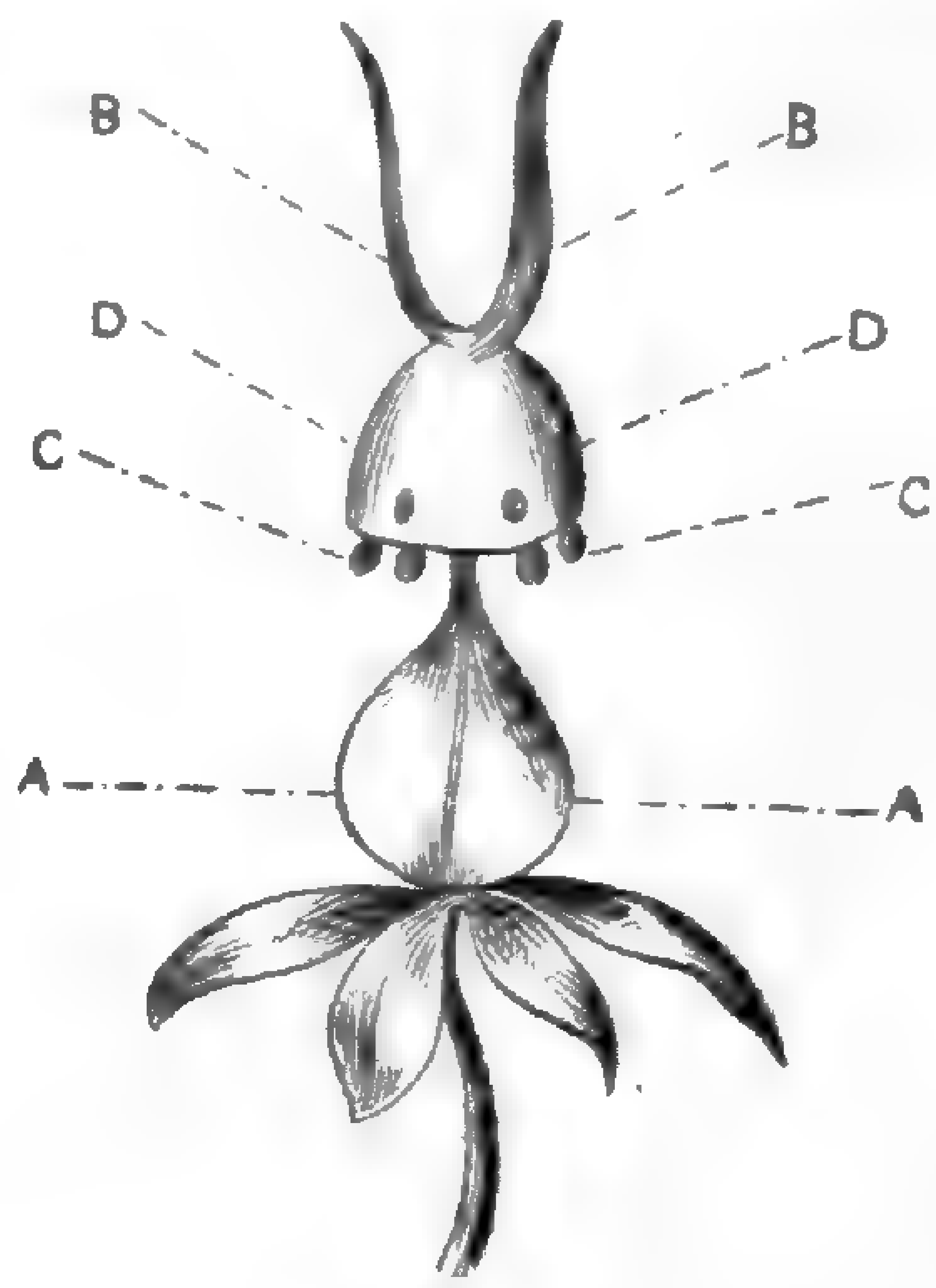


FIG. 6.

In Fig. 5, the stamineal mass or corona-staminea: A, anther-wings; B, exterior spur-like processes to stamen.

Fig. 6, gymnecium, showing ovaries, A; stigma, B; pollen-masses, C; and glands, D.

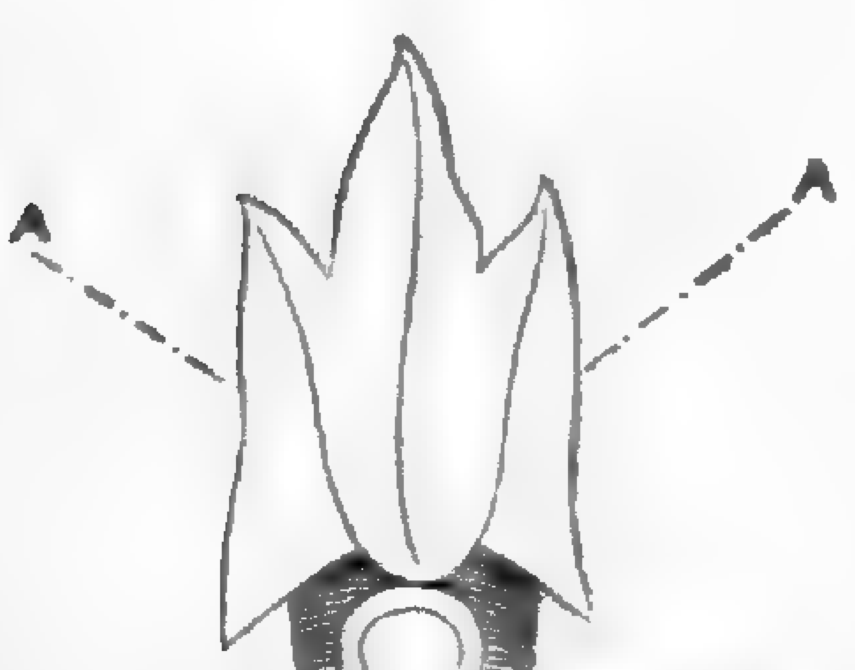


FIG. 7.

FIG. 8.

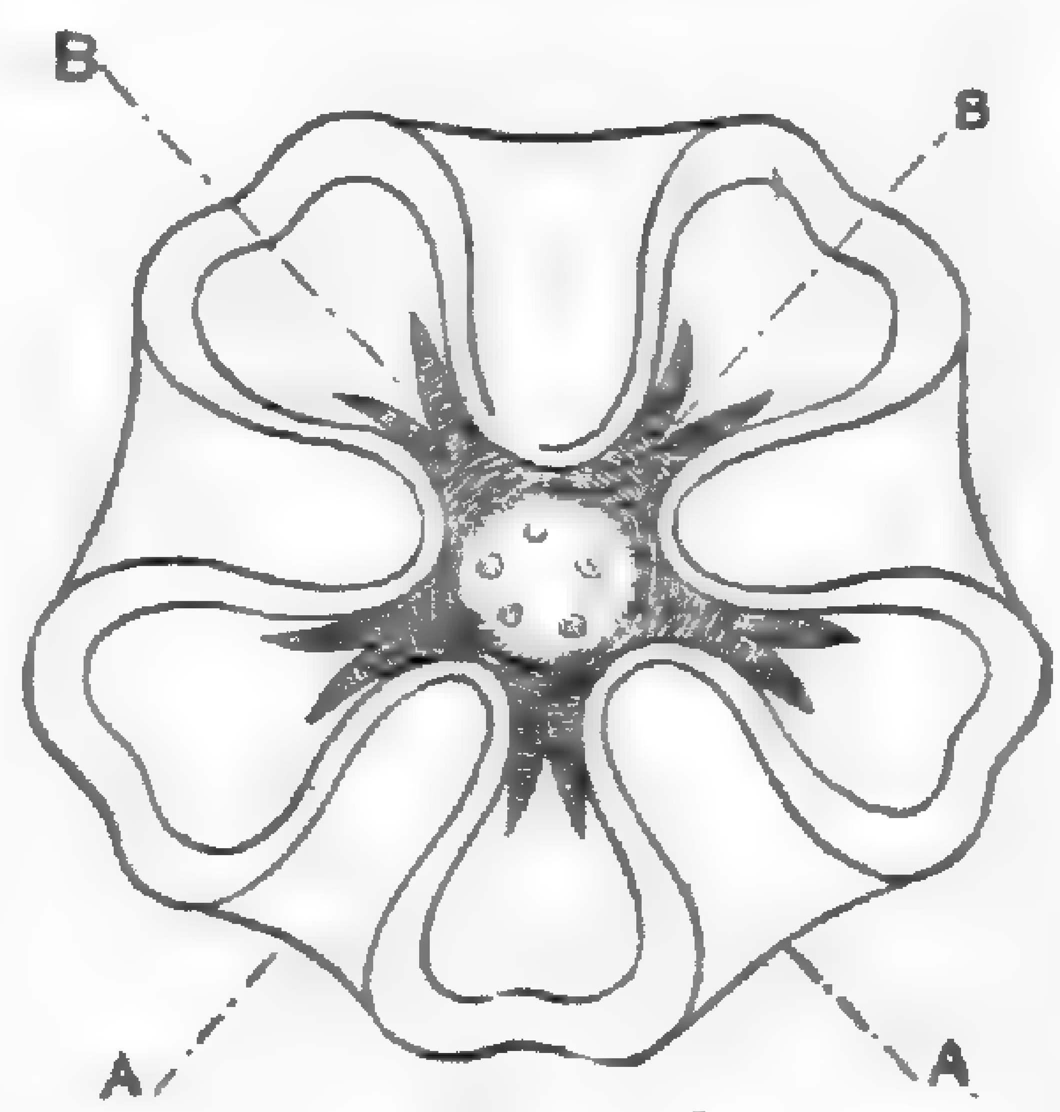


FIG. 9.

Fig. 7, stamen, showing wing-like processes, A, A, and exterior spur, B.

In Fig. 8 a side-view of the stamen figured in 7 is shown. A, A, side-views of wings; B, spur.

Fig. 9, oral view, showing how the spurs A, A, A, A, A head in against the wings B, B, the upper edges of which are seen in pairs, B, B.

The riper flowers, apparently, are not sought by the moths; probably the tempting nectar has lost its sweetness or *bouquet*, or, perhaps, in some way has become changed, or, may be, has been absorbed by the flower in the process of ripening. I have in several instances plucked flowers to which living moths were attached, and have pinned such flowers to the floor of an insect-box, and subsequently found that the moths had freed themselves. The tissues of the flower begin to soften and wilt very soon after separation from the plant. In cases where the moths had freed themselves as above, they seldom lived many hours, and appeared to have died from exhaustion caused by their efforts to escape. As between the moth and the flower, the release or death of the former seems to be reduced to the single point, namely, whether the moth or the flower has the greater vitality.

As some plants are exceedingly sensitive, I thought it possible that the flowers of *Araujia* might be so. I accordingly experimented with a bristle, to learn whether the rigidity of the anther-wings might not be owing to irritability caused by the proboscis of the moth, but was unable to detect any effect of this kind as resulting from friction. By following the same movement or curve that a moth has to follow with its proboscis in reaching up towards the more interior structure of the flower, and then following the further motion that is made by the moth when it tries to withdraw its proboscis, my bristle was held fast between the edges of the wing-like extensions, the same as is the proboscis of a captured moth.

As pertaining to the foregoing remarks, I will mention the following species of Lepidoptera, etc., as determined by various entomological friends, taken by me during three seasons—1880–83—from the blossoms of *Araujia*:

Colias chrysotheme var., *Colias kewaydin*, *Pamphila sylvanus*, *Pyrameis caryæ*, *Pyrameis hunteri*, *Pyrgus syrictus*, *Syrichthus tessellatus*, *Plusia pasiphæia*, *Plusia gamma*, *Agrotis c-nigrum*, *Heliothis* sp.

Other insects are often found upon or within the flowers, such as bees, ants, and beetles, but seldom as prisoners. Among the latter the little (beetle) *Throscus sericeus* Le Conte was detected.

Of the species above named, probably two-thirds of the lepidopterous forms that are caught belong to the three species *Plusia pasiphæia*, *Plusia gamma*, and *Agrotis c-nigrum*.

The list I have submitted contains *eleven* species, as named.

The species of moth which is most frequently trapped on this side of the continent, I have been told, is *Plusia precationis.* It will be noticed that two species of this genus are included in my California list.

As to the simple, ingenious, and effective mechanism exhibited in the structure of the flowers of *Araujia*, whether the same is a device of nature to insure fertilization, through the agency or assistance of the insects it catches, and consequent perpetuation of this plant species, is a question I am unable to answer. Upon the theory of utility, we can hardly conceive of its being without a purpose, or that the peculiar phenomena of plant and insect association in the instance before us are without function, aim, or result, other than the trapping of the insects before mentioned.

BIOLOGICAL INSTRUCTION IN UNIVERSITIES.[1]

BY C. O. WHITMAN.[2]

THE discussion of biological instruction in relation to universities would seem properly to fall to those whose professional standing and experience lend weight to their words; but there are some aspects of the question which lie open to all whose connections with university life have been such as to afford more or less varied opportunities for observation and reflection.

At our last annual meeting Prof. Farlow discussed the question in relation to elementary instruction in colleges and schools. It was made very clear that "*the college instructor must still regard the student who studies under him as a school-boy whose capacity for observing and investigating natural objects has been blunted by a one-sided course of instruction at school.*" The charge is a most grave and startling one; but I think no one would venture to question its entire justice.

We know exactly where the evil lies, but I think the remedy is too generally sought in the wrong direction. It is, in my opinion, a great mistake to suppose that it lies within the power of

[1] Read before the American Society of Naturalists, December 29, 1886.

[2] Director of the Lake Laboratory, Milwaukee.

teachers to abandon methods that lead to such deplorable results. Place in every one of these fitting-schools to-day teachers who know full well the injurious effects of the methods employed, and they would be powerless to abolish the system and replace it by a better. They represent only one of the factors—and that not the most important one—which must co-operate to effect the needed reform. Prof. Farlow suggests that "improvement in the quality of college graduates who could teach biology in schools, if there was any demand for it, gives room for hope." This suggestion brings back at least a part of the responsibility for unsatisfactory methods of teaching to the doors of our colleges and universities. In this direction, more than in any other, lies the remedy for the evils complained of. Our higher institutions of learning represent the creative and directive factor; and to them we must look, first of all, for the supply of competent teachers, and, in the second place, for the creation of that healthy public sentiment which will give support and protection to teachers and school boards in carrying out the desired reforms. The interest of the educated public must be aroused to the supreme importance of cultivating the observing powers of the young before any suitable provision for their training can be expected.

But how shall the capacity for observation be brought into general respect and esteem? Evidently the universities must move first. The stream does not rise higher than its source, and it can hardly be considered a reproach to our preparatory schools if they do not attach great importance to methods of training, the value of which is not made apparent in the requirements for admission to college. It is the fashion to speak of the "cramming system" as the Pandora's box of all the evils we discover in school methods. But where in this country is the college or university which does not foster the system in its rankest form? It is difficult to see why the system is not as good for the schools as for the universities; and it seems pertinent to ask how the latter, while harboring it, can ever expect to eradicate it in the former. But is it, after all, the system itself against which complaints should be directed? We all have to "cram," more or less; and the process is perfectly legitimate and harmless within certain limits. School education begins in cramming, and all through life we go on stuffing the mind with facts, of which comparatively few can be assimilated and turned to immediate practical account, while others are simply stored up in the crude undigested state. Observation itself is largely a process of cramming; and every investigator knows that science always keeps a large stock of these unassimilated facts on hand. If the observer places a high value on first-hand knowledge, he knows also how to appreciate results obtained by others, and how to make these his stepping-stones.

But let me not be misunderstood. I do not underestimate the difference between feeding and cramming, while insisting that both processes are legitimate. The trouble now is, that we have too much cramming and altogether too little feeding, as a direct result of a one-sided course of instruction. The field of instruction must be broadened so as to include those branches of knowledge which are now generally acknowledged to afford the best means of developing the powers of observation and comparison. The biological sciences hold this position in the estimation of all, or nearly all, who are competent to judge. Elementary training in these branches should begin in the primary schools, as they do in Germany, and be carried on through the grammar and high schools.

This important reform can only be effected through influences emanating from our higher educational institutions. They must make such a reform not only possible, but also necessary. So long as they usurp the functions of the schools, and persist in devoting a large share of their time to that elementary training which ought to begin in the primary and end in the high schools, so long shall we decry in vain the evils of present methods and courses of school instruction. Turn over to the schools the work that belongs to them, then require it of them, and they will find the means to accomplish it readily enough. By all means let biological instruction in universities be pitched on a higher key. Emerson hit the truth very squarely when he said, "Colleges have their indispensable function,—to teach elements. *But they can only highly serve us when they aim not to drill, but to create.*"

Is it presumption to assert that our higher educational system, so far as biology is concerned, aims too low? Then it must be presumption to affirm a truth susceptible of the clearest demonstration. Fortunately, I may assume that such a demonstration is not required here. But if any one doubts the assertion, let him compare the best organized biological department this country affords with that found in the best German universities. The student who repairs to Berlin, Leipzig, Heidelberg, Würzburg, Freiburg, Munich, and Jena, finds there institutions that aim to make good the title they wear,—institutions that strive to represent every department of knowledge at its best, and to provide room for every form of intellectual activity. Whatever his special bent, he finds in the lecture-courses and the laboratories precisely what he needs. Representing his specialty, he sees men known and revered throughout the scientific world for their contributions to knowledge. He is recognized, not as an irresponsible school-boy, to be marked for absences, ranked for recitations, and rewarded, after a prescribed number of years of study and decent behavior, with a "graduating" degree; but as a man who knows, or ought to know, his purpose, and who, if he ever expects to attain the distinction of a degree, must demonstrate his eligibility thereto by making some worthy contribution to the advancement of knowledge in his own chosen field. Professor and student both work together to the same great end,—the advancement of science. The influences surrounding one arouse every latent energy, and kindle a love and zeal for work that fairly blaze with enthusiasm. The ideal catholicity of aim that everywhere prevails, and the whole-souled consecration of energy to research, create an intellectual atmosphere that is all aglow with inspiration. And what an imposing array of scholarship is here organized for pushing on the work of each department! Does not the enormous productivity of the twenty-one workshops of science represented in the universities of the German empire proclaim with an emphasis that makes argument superfluous, the importance of high aims in the organization of each and every department of instruction? In Germany, as here and everywhere, the character of the preparatory schools is determined by that of the academic system. But university influence does not stop with the enforcement of eight or nine years of rigid discipline in the gymnasium; it pervades the entire school-system, and is thus in a very large measure directly responsible for the methods and courses of instruction pursued.

The simple secret of this dominating influence is *devotion to research* as the prime means and the chief end of higher education. It is this same crowning feature which creates and keeps alive popular respect for the investigator and his methods, and which makes biological training not only a possible but also a recognized essential of school-work.

With such an example before us, it ought to be unnecessary to urge the practical lesson it teaches. But we are under the spell of our "historical roots," and there seems to be a too general conviction, or conceit, that we are doing fairly well under the circumstances. In some quarters, allusion to the superiority of the German system is enough to raise a storm of indignation against the "grumbler." And yet we go on year after year sending students abroad to complete their biological education; and in nine cases out of ten they turn their backs on the land of "historical roots" and repair to Germany. The proverbial thoroughness of the Germans, their mastery of methods, the wealth of their literature, and the liberality with which they provide for instruction and assistance in every branch of knowledge, appeal to the strongest instincts and needs of every student who, having resolved to devote his life to the unremunerative service of science, and having availed himself of the best that home instruction affords, still finds himself too poorly equipped for special work.

I am well aware that within the last five or ten years there has been some improvement in this country, both in the methods and the aims of biological instruction. I have in mind especially zoological instruction, but have good reason to believe that the same is true of the botanical side. But unless my observation is greatly at fault, we are almost wholly indebted to German sources for these improvements. A few of our best colleges and universities—unfortunately not all—have in the service of the biological departments men trained in European laboratories, who, in spite of the exorbitant demands made upon their time and energy for elementary courses, undertake to provide for instruction in modern methods of research, and to introduce students into special lines of work. It is certainly one of the hopeful signs, that the incredulity which such methods and courses first encountered is fast lapsing into passive resignation. But I think it is to be regretted that such praiseworthy aims should meet with mere indifferent toleration instead of hearty co-operation and encouragement,—and this too in the very places where their high value ought to receive its first recognition.

It is certainly time that the higher side of biological instruction should receive more attention, and it is unquestionably one of the first duties of an institution, which strives to be a university in reality as well as in name, to see to it that the productive side of the department is encouraged and maintained at a level of high respectability. Scientific activity flourishes only when research is made the dominant aim, and when, for the realization of the aim, the working forces are organized with a view to representing every important side of the department, and on a basis which provides for giving the larger share of energy to productive investigation. For the efficiency of the department, then, we have this double test,—*high aims* and *comprehensive organization.*

What constitutes a properly organized corps of instructors, and what should be the paramount aim in any given department of science, are questions for the specialists in that department. It is the position, the scope, and the tendencies of the sciences represented which claim foremost consideration in such questions. The value of any plan of organization will depend, not upon whether it will provide for the more general needs ascertained by experience, but upon its capacity for expansion and its ability to supply needs not already clamored for. Any organization trimmed to provide merely what the uninstructed public ask for can never fulfil its highest function, which is to *create* and *direct*, not to adapt and conform. An educational institution which limits itself to elementary instruction may advertise itself as a university; but where is the educated public that does not see through the mask of such ill-founded pretensions?

It has been said that in German universities too exclusive regard is paid to the promotion of scientific and literary activity. I wish that academic administration in this country could be justly charged with such a fault. But our boasted "practical" wisdom has never been known to err in the same laudable direction. We hear altogether too much about the necessity of providing for the general purposes of education; but seldom any allusion to the fact, which appears so eminently practical to some of us, that a liberal provision for the higher ends of education is the only means by which those general purposes can be successfully reached. Let a department be organized with a view to the fulfilment of its higher functions, and you place it on the only basis that admits of the healthy exercise of its non-productive functions. Take care of the creative functions, and the vegetative functions will take care of themselves. The precept is as pertinent to the life of a university as to that of an individual.

The question then reduces itself to this,—How can a biological department be most efficiently and comprehensively organized for the fulfilment of its higher purposes? Every special question which the subject presents finds its solution in the same direction. Take, for example, the preparation of students for teaching biology. It is plainly not a question of turning the biological department into a sort of factory for the manufacture of teachers of the stamp which may just now have the highest market value. The question is not how to fit, but how to equip,—not how young men can be fitted to teach natural history as it happens to be taught now, but how they can be most thoroughly prepared for improving and renovating existing methods and systems. The best teachers have always been investigators; hence the aim should be, on the part of one who proposes to follow teaching as a profession, to become an investigator, and, on the part of university instructors, to make as many investigators as possible. This may be an ideal plan, which, in the majority of cases, cannot be fully carried out on either side; but this, to my mind, so far from being an objection, is its best recommendation. All that I claim is, that the most satisfactory results are to be obtained by working in this direction. A plan is not necessarily impractical because its fullest realization is impossible; and in the organization of any department of instruction in a university, the highest results are never attained where anything less than ideal aims are tolerated.

A practical question of great importance here presents itself: What should be the attitude towards, and what the advice to, students who have a strong predilection for biological research, but who will be dependent for their support on the salaries which they may earn? I believe the policy of discouraging such a purpose has been carried to a dangerous extreme in this country. Those who know by personal experience what it costs to venture in this direction need no apology for the impatience which is aroused, when they see the real difficulties increased by the incubus of discouraging advice and an indifferent, unsympathetic, chilling attitude. Such advice may do little harm to one who has the self-reliance to "plant indomitably on his instincts, and there abide till the huge world comes round to him," and the courage to defy every obstacle which timid counsels can conjure up; but it works like a damper on the aspirations of many a less resolute mind, and has unquestionably done much to retard the progress of biological work in this country. When those who speak for our leading universities tell us that these institutions are the best places for the prosecution of research, and that we must look to them for most of the work in pure science, we would fain believe it; but when, in the next breath, they proceed to give us solemn warning that we are under the curse of Adam, and that "*the first business of every man is to win his bread*," we begin to suspect that, if the intentions are all right, the policy may be all wrong. When, still further, we are advised that our first concern should be to bring "*to the educational exchange qualities which are always in demand, and which always receive remuneration*," we begin to see that, if such councils are to prevail, the days of "our long apprenticeship to the learning of other lands" are not yet numbered. How utterly unworthy appears such advice by the side of Emerson's inspiring exhortations to self-reliance! Some men never bow to Adam's curse, nor rebel against it; but, busy with higher purposes, ignore it. Such a man was Louis Agassiz. One such example, one such counsellor, puts to shame a world of those who place policy above the noblest aims of life. You might as well command the waters of Niagara to turn back as attempt to still the intellectual hunger of such men by pointing out the difficulties and disappointments which they are likely to encounter if they obey their instincts.

I am certain that every man who places the pursuit of pure science above public applause and the allurements of wealth, in a word, above every mercenary consideration, must be filled with surprise and regret at the avowal of such sentiments by those who are shaping the destinies of our higher educational establishments. Is that what is needed in a country that can boast of nothing higher than the performances of mechanical skill, where there is little market for anything above a bread-and-butter mediocrity, and where there is so little appreciation for any science which cannot be converted into immediate wealth? Just imagine what a dreadful misfortune it would be for this country "if we should find in the course of a few years a superabundance of men with rare acquisitions of a kind for which there is no demand!" Is it possible that any one who realizes the destitution of this country in respect of men devoted to science, and who is aware of the fact that the number must be increased a hundred-fold before a position of fair respectability can be reached, can take alarm at the disposition sometimes shown by graduate students to engage in special lines of research? Whoever fears the tendency of modern science to specialization must have failed to catch the full significance of this tendency. Such counsellors have fallen into the same error against which they warn others. For, instead of looking at the subject broadly and in the light of history, they fix their eyes on some real or imaginary excesses. They find a few narrow-minded men engaged in very special lines of investigation,—men who know their specialty well, but little else,—and they infer that narrowness and specialization necessarily go together. The term specialization has thus been degraded, and specialists find themselves heirs to an opprobrium for which the only foundation is a vulgar misconception. Every specialist who stands on the approval of his own conscience is well able to bear his cross; but he cannot look with indifference on the tendency to superficiality which such a misconception directly encourages. I have in mind more than one aspirant for scientific fame who, from sheer fear of being too special, has fallen a victim to the curse of superficiality. Certainly missionary work is not very far from our doors, and if I am the least qualified of all to undertake such work, I trust I shall not transgress the bounds of propriety in urging others to do it. When we remember that specialization has marked every step in the progress of science, and that every advance in the future must inevitably carry us still farther in the same direction, we can hardly wonder that those who, as spectators, see the grand army of workers splitting up into more and more numerous divisions, as the necessity for more special work arises, should regard the whole movement as one tending to weakness and narrowness. But those who march in the ranks can have no excuse for such a groundless fear. They at least ought to know that there is just as little reason for making specialization a synonyme for narrowness as for connecting generalization with shallowness. None can know better than they that specialization is the only proper basis for generalization, and that the two are indissolubly related as means to end. But there are hangers-on who wear the uniform and are ambitious to grab the honors without sharing the work. They are a most dangerous foe, for their pretensions are a source of deception to honest people. These are the men who, under the delusion that shallowness is breadth, flit from point to point, snatching a little here and a little there, learning a little of everything and not much of anything, aiming to amaze the vulgar with glib talk and profuse writing, while they disgust every conscientious worker. To such the hard toil of special work is irksome drudgery, proper enough for minds of small calibre, but quite foreign to the philosophical province to which they aspire. You would never recognize these impostors by the names they desecrate; for some of them call themselves zoologists, and insist that staring at the outside of things is the only proper method of teaching or investigating; and a few, seeing that biologist is a word of many meanings, and therefore just adapted to their versatile character, flourish that title. The distinctive mark of the whole genus, as you will always learn on close acquaintance, is a single eye set in the hindhead instead of the forehead. They know nothing of the tendencies of the biological sciences, and are therefore as incapable of steering their own craft as of directing others. The backward vision incapacitates them from ever understanding either the needs of the future or the lesson of the past. They would organize a biological department on a basis suited to the times of Linnæus; because, forsooth, Linnæus was a great man, whose mind could compass a "Systema Naturæ" which embodied all that was then known of the distinctive characters of minerals, plants, and animals. This was natural history in the broadest acceptation of the phrase, and it is only the breadth, as pure surface expansion, that these men look at. They cannot, or will not, see that our intellectual horizon has been extended in proportion as science has made it necessary to sacrifice superficial breadth to profundity.

The misfortune is that these opinions are so generally accepted, as the state of biological instruction in the four hundred or more institutions of the country calling themselves colleges and universities abundantly shows. Argument will never dislodge them; they can be reached only through the leavening influence of high examples. A single biological department organized on a basis broad enough to represent every important branch at its best, and provided with the means necessary to the freest exercise of its higher functions, would furnish just the example we stand in need of. It is clear enough where we ought to look for such examples, but it is not so clear where or when we shall find them. We have often heard of the "coming university," but still it comes not. Men and money are all that is required to create such a department, and the country has both. We wait only for the rare conjunction of wisdom, will, and means for the realization of the long-postponed expectation.

Having considered the general aims and principles which should determine the organization of a biological department, some of the more dangerous prejudices in the way of improvement, and the source and direction of reform, it remains to notice more precisely the ground to be covered by such a department. As before remarked, the nearest approach to an ideal organization is to be found in German universities. The biological sciences are distributed among five separate institutes, called, respectively, the botanical, the zoological, the physiological, the anatomical, and the pathological. Each institute consists of a spacious edifice, containing special and general laboratories provided with instruments and other necessaries for instruction and investigation, lecture-rooms, library, and museum. The zoological institute has, besides, its aquaria, terraria, and garden; and the botanical institute has, of course, its experimental garden. At the head of the official staff of each institute is the professor, with two or more able assistants, and other subordinates trained to aid in laboratory work. But this is not all, for we often find as many as three or four, and sometimes as many as five or six, professors, ranking as *ordinary*, *ordinary and honorary*, and *extraordinary*, all engaged in the work of a single institute. It is a common thing to find the lecture-work in any given subject divided among three or four eminent investigators, in such a manner that each special side of the subject has its special course of lectures extending through one or more entire semesters. This is the case, for example, with histology and embryology, subjects which are often pointed out in this country as the dangerous extremes of specialization. This division of labor has thus been carried much farther than a superficial glance would lead one to suppose. And has this principle been carried too far? and are there now signs of a reaction? Absolutely nothing of the kind. On the contrary, the marvellous rapidity with which the biological sciences are developing carries it still farther every day. And as the process goes on instruction becomes more thorough and, at the same time, more comprehensive, while investigation marches on with increased speed from one achievement to another. Specialization is a terror only to those who do not understand it. A German specialist devotes ten or fifteen years to the study of the development of the chick or the frog, and a German university provides courses of lectures on just such special subjects as these. Does that appear narrow? Those who imagine that such profound special study means intellectual narrowness could profitably spend five years in the study and contemplation of the facts presented in one of those embryological monographs. In the course of such an experience they might discover that the embryologist's conception of a chick is a little too broad for their idea of a barn-yard fowl. By the time they had followed this unpretentious creature through the animal kingdom, studied the comparative lessons of its anatomy, histology, embryology, and physiology, they would begin to comprehend what a fearfully general thing specialization really is. It might occur to them that more thorough methods of research have made it necessary to limit the field of original work while broadening immensely the field of vision.

The natural history of the last century, as I have said, included mineralogy as well as botany and zoology. In course of time mineralogy dropped out, while zoology and botany were drawn into the closer relation denoted by biology. The word biology was proposed as long ago as 1802, simultaneously, but independently, in France and Germany, by Lamarck and Treviranus. Since that time both divisions of biology have grown to something more than single sciences. Each represents now a great department of knowledge, embracing half a dozen or more distinct sciences. Zoology—leaving aside botany—is subdivided into anatomy, histology, embryology, phylogeny, taxonomy, and physiology. Cytology is a new offshoot, developed from embryology and histology, and forming a common basis for the botanical and zoological sciences.

A lengthy paper might profitably be devoted to the consideration of the scope of these several sciences, with a view to showing how extensive ought to be the provision for instruction and investigation in each. It is not my intention, however, to pursue the subject further here. It suffices for the present to say that no one of them can be adequately represented by less than two instructors; and some of them require, at least, as many as four or five.

It must be evident to all that no approximation to such a standard of organization is anywhere to be found in this country. It is a common error to suppose that zoological instruction is liberally provided for by one professor and one assistant. You will find that this idea, or a worse one, still regulates the policy of our leading colleges and universities. The result is that we find the professor trying to make a single course of lectures cover anatomy, histology, embryology, cytology, physiology, distribution, evolution, and in fact everything that can be legitimately squeezed in. Allowing that there are circumstances which make it appear advisable to spread so exceedingly thin,—and that is fully enough to concede,—is it not perfectly evident that, where this is the best that can be offered, no claim can be justly made to providing for the higher needs of lecture-courses? But what shall be said of those institutions which aim to take foremost rank among our universities, and yet regard zoology as too narrow a field for one man, requiring the professor to shoulder the burden of directing the instruction in zoology and botany, and in some cases physiology too? And ought we to let it go unmentioned that some colleges and universities of high respectability still abide in the typical Linnæan stage of development, leaving one man to grapple with the whole system of nature? Still greater marvels of persistent ancestral types might be placed before you, but certainly they would not improve the picture.

Our need is a few creditable examples, and to those who know what such examples call for we must look for their ultimate attainment.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 444.)

CABBAGE. *Brassica oleracea capitata* L.

THE headed cabbage, in its perfection of growth and its multitude of varieties, bears every evidence of being of ancient origin. It does not appear, however, to have been known to Dioscorides, or to Theophrastus, of the Greeks, nor to Cato, among the Romans; but a few centuries later their presence is indicated by Columella[2] and Pliny,[3] who, in his "Tritianon" kind, speaks of the head being sometimes a foot in diameter, and going to seed the latest of all the sorts known to him. The descriptions are, however, obscure, and we may well believe that if the hard-headed varieties now known had been seen in Rome at this time they would have received mention. Olivier de Serres, quoted by A. Soyer,[4] says, "White cabbages came from the north, and the art of making them head was unknown in the time of Charlemagne." Albertus Magnus,[5] who lived in the thirteenth century, seems to refer to a headed cabbage in his "Caputium," but there is no description. The first unmistakable reference to a cabbage that I find is by Ruellius,[6] in 1536, who calls them *capucos coles* or *cabutos*, describes the head as globular and often very large, even a foot and a half in diameter. Yet the word *cabaches* and *caboches* used in England in the fourteenth century indicates the cabbage as then known and distinguished from *coles*.[7] Ruellius also describes a loose-headed form called *Romanos*, and this name and description, when we consider the difficulty of heading cabbages in a warm climate, would lead us to believe that the Roman varieties were not our present solid-heading type, but loose-headed, and perhaps of the Savoy class.

Our present cabbages are divided by De Candolle[8] into five types or races,—viz., the flat-headed, the round-headed, the egg-

[1] Director of the New York Agricultural Experiment Station, Geneva.

[2] Columella, lib. x. l. 138.

[3] Pliny, lib. xix. c. 41.

[4] Soyer, Pantropheon, 61.

[5] Albertus Magnus, De Veg., lib. vii. c. 90.

[6] Ruellius, De Natura Stirpium, 1536, 477.

[7] The Forme of Cury, 1390, Warner's Antiq. Culin., 1791.

[8] A. P. De Candolle, Memoir, Lond. Hort. Soc. Trans., 1821.

shaped, the elliptic, and the conical. Within each class are many sub-varieties. In Vilmorin's standard work, "Les Plantes Potagères," 1883, fifty-seven kinds are described, and others mentioned by name. In the "Report of the New York Agricultural Experiment Station" for 1886, seventy varieties are described, excluding synonymes. In both cases the Savoys are treated as a separate class, and are not included. The history of these forms, as well as I can make out, will now be given.

The Flat-Headed Cabbage.—The type, the "Quintal." The first appearance of this form that I find is in "Pancovius Herbarium," 1673, No. 612. A "common flat-winter," probably this form, is mentioned by Wheeler,[1] 1763; the "flat-topped" is described by Mawe[2] in 1778. The varieties that are now esteemed are remarkably flat and solid.

The Round Cabbage.—The type, the "Early Dutch Drumhead." This appears to be the earliest form with which we are acquainted, as it is the only kind figured in our early botanies, and was hence presumably the only, or, perhaps, but the principal, sort known during several centuries. The following synonomy is taken from drawings only, and hence there can be no mistake in regard to the type:

Brassicæ quartum genus. Fuch., 1542, 416.
Kappiskraut. Roszlin, 1550, 87.
Caulis capitulatus. Tragus, 1552, 717.
Brassica capitata. Matth., 1558, 247; Pinæus, 1561, 163; Cam. Epit., 1586, 250.
Kol oder Kabiskraut. Pictorius, 1581, 90.
Brassica alba sessilis glomerata, aut capitata Lactucæ habitu. Lobel ic., 1591, i. 243.
Brassica capitata albida. Lugd., 1587, i. 521; Dod. Pempt., 1616, 623.
Brassica capuccia. Cast. Dur., 1617, 78.
Brassica capitata alba. Bodæus, 1644, 777; J. Bauhin, 1651, ii. 826; Chabræus, 1677, 269.

The descriptive synonymy includes the "losed" cabbage, a great round cabbage of Lyte's "Dodoens," 1586; the White cabbage cole of Gerarde, 1597; the White Cabbage of Ray, 1686; the chou pomme blanc of Tournefort, 1719; the English of Townsend, 1726; the Common white of Wheeler, 1763; the

[1] Wheeler, Bot. and Gard. Dict., 1763, 79.   [2] Mawe, Gard., 1778.

English, or late, of Stevenson, 1765; the Common round white of Mawe, 1778, etc.

The Egg-Shaped.—The type of the "Sugar-Loaf." Vilmorin[1] remarks of this variety, the Sugar-Loaf, that, although a very old variety, and well known in every country in Europe, it does not appear to be extensively grown anywhere. It is called *chou chicon* in France,[1] and *bundee kobee* in India.[2] It is mentioned by name by Townsend,[3] in 1726; by Wheeler,[4] in 1763; by Stevenson,[5] in 1765; by Mawe,[6] in 1778, etc. Perhaps the large-sided cabbage of Worlidge[7] and the long-sided cabbage of Quintyne[8] belong to this division.

The Elliptic Cabbage.—The type is the "Early York." This is first mentioned, so far as I can ascertain, by Stevenson[5] in 1765, and he refers to it as if a well-known sort. According to Burr, it came originally from Flanders. There are now many varieties of this class.

The Conical Cabbage.—The type is the "Filderkraut." This race is described by Lamarck[9] in 1783, and, if there is any constancy between the name and the variety during long periods, is found in the *Battersea*, named by Townsend[10] in 1726, and a whole line of succeeding writers.

It is certainly very singular that but one of these races of cabbage received the notice of the older botanists (excepting the one flat-topped given by Chabræus in 1677), as their characteristics are extremely well marked, and form extreme contrasts between the conical or pointed and the spherical headed. We must, hence, believe that they either originated or came into use within a recent period. How they came, and whence they came, must be decided from a special study, in which the effect of hybridization may become a special feature. From the study of sports that occasionally appear in the cabbage-garden, the suggestion may be offered that at least some of these races have been derived from crossings with some form of the Chinese cab-

[1] Vilmorin, The Veg. Gard., 1885, 110.
[2] Speede, Ind. Handb. of Gard., 1842, 112.
[3] Townsend, Seedsman, 1726, 26.
[4] Wheeler, Bot. and Gard. Dict., 1765, 79.
[5] Stevenson, Gard. Kal., 1765, 119, 26.
[6] Mawe, Gard., 1778.
[7] J. W., Gent. Syst.-Hort., 1683, 202.
[8] Quintyne, Comp. Gard., 1693, 189.
[9] Don, Gard. Dict., 1831, i. 223.
[10] Townsend, Seedsman.

bage, whereby form has become transferred while the characteristics of the Chinese species have disappeared. On the other hand, the Savoy class, believed to have origin from the same source as the cabbage, have oval or oblong heads, which have been noted by the herbalists.

The Cabbage is called, in France, *Choux cabus*, *chou capu*, *chou en tête*, *chou pomme*, *chou pomme à feuille lisse;* in Germany, *Kopfkohl*, *Kraut;* in Flanders, *kabuiscool;* in Holland, *slutkool;* in Denmark, *hoved kaal;* in Italy, *cavolo cappuccio;* in Spain, *col repollo;* in Portugal, *couve repolho;*[1] in Sweden, *husvudkal.*[2]

The ancient names were, in France, *capucos coles*, or *cabutos*, Ruel., 1536; *chou cabus*, Lyte, 1586; in Germany, *Kappiskraut*, Adv., 1570; *Kapskraut*, Pin., 1561; in Italy, *cavolo cappuccio* and *cappuzzino*, Pin., 1561; in Spain, *repolho* and *colhes morcianos*, Pin., 1561.

CAPER. *Capparis spinosa* L.

The caper, although rarely grown in this country, forms an object of extensive culture in the Mediterranean region for the sake of the flower-buds, which enter into commerce for use as a pickle or appetizer. The Greeks of the Crimea eat the shoots as well as the buds,[3] and in Egypt the fruit, which in this variety is very large, is eaten by the Arabs.[4] In Sindh and the Panjab, India, the fruit is also pickled and eaten.[5] According to Ruellius,[6] Aristoteles and Theophrastus describe the plant as not cultivated in gardens; but in his time (1536) it was in the gardens of France. Unger[7] says it was known to the ancient Greeks, and the renowned Phryne, at the first period of her residence in Athens, was a dealer in capers. The plant has become widely distributed, and was introduced into South Carolina about 1755.[8]

There are two forms now known,—the spined and the unarmed. The former is the most esteemed, although *C. inermis* is also grown in France. Both kinds have been known for a long time, as the following partial synonymy indicates:

[1] Vilmorin, Les Pl. Pot., 1883, 103.
[2] Tengborg, Hort. Culin., 1764, 23.
[3] Pallas, Trav., iv. 224.
[4] Wilkinson, Ancient Egyptians, ii. 29.
[5] Brandis, Forest Flora, 14.
[6] Ruellius, De Nat. Stirp., 1536, 561.
[7] Unger, Plants used as Food by Man, U. S. Pat. of Rept., 1859.
[8] Hist. of the Mass. Hort. Soc., 29.

I.

Capparia. Ruellius, 1536, 561.
C. spinosa, fructu minore, folio rotundo. Bauh., Pin., 1623, 480.
C. spinosa. J. Bauh., 1651, ii. 63.
C. spinosa. Linn., Sp., 720.
Caprier. Vil., 1883, 55.
Capers.

II.

Capparis non spinosa fructu majore. Bauhin, Pin., 1623, 480.
C. non spinosa. J. Bauhin, 1651, ii. 63; Tourn., Inst., 1719, 261.
C. inerme. Naud. & Decaisne, Man., iv.
Caprier, variete sans epines. Vilm., 1883, 55.

The Caper-tree is called, in France, *caprier;* in Germany, *Kapernstrauch;* in Flanders and Holland, *kapperboom;* in Italy, *cappero;* in Spain, *alcaparra;* in Portugal, *alcaparreira.*[1]

In Arabic, *kabar*, or *kabbar;*[2] in Afghan, *kabaria;* in Thibet, *kabra;* in Panjab, *kaur*, *kiari*, *kakri*, *kandee*, *taker*, *ber*, *barari*, *bauri*, *bassar;* in Sindh, *kalvari.*[3]

CARAWAY. *Carum carui* L.

The seeds of caraway were found by O. Heer[4] in the *débris* of the lake habitations of Switzerland, which establishes the antiquity in Europe. This fact renders it more probable that the Careum of Pliny[5] is this plant, as also its use by Apicius[6] would indicate. It is mentioned as cultivated in Morocco by Edrisi in the twelfth century; and in the Arab writings, quoted by Ibn Baytar, a Mauro-Spaniard of the thirteenth century, it is likewise named; and Fluckiger and Hanbury think the use of this spice commenced at about this period. It is not noticed by St. Isidore, Archbishop of Seville in the seventh century, although he notices dill, coriander, anise, and parsley; nor is it named by St. Hildegard in Germany in the twelfth century. But, on the other hand, two German medicine-books of the twelfth and thirteenth centuries use the word *cumich*, which is still the popular name in Southern Germany. In the same period the seeds appear to have been used by the Welsh physicians

[1] Vilmorin, Les Pl. Pot., 1883, 55.
[2] Delile, Fl. Ægypt, illust.
[3] Brandis, Forest Flora, 14.
[4] O. Heer, Gard. Chron., 1866, 1068.
[5] Pliny, lib. xix. c. 49.
[6] Apicius, lib. i. c. 30; ii. c. 4; viii. c. 2.

of Myddvai, and caraway was certainly in use in England at the close of the fourteenth century,[1] and is named in Turner's "Libellus," 1538, as also in "The Forme of Cury," 1390.

Caraway appears as a wild plant in Iceland, Scandinavia, Finland, Arctic, Central, and Southern Russia, Persia, and in Siberia; also Eastern France, Spain, Central Europe, America, and the Caucasus, as well as in the Western Himalayas. It is largely cultivated in a distinct variety in Morocco. In commerce the seed is received from Finmark, Finland, and Russia, Prussia, Holland, and Morocco.

This plant is cultivated in gardens for its under leaves, which are used for flavoring soups and salads, and for its seeds, which are often mixed with bread, or in making "seed-cakes," and in Germany are put into certain cheeses. The root is tender, and is better than a parsnip, as was observed by Parkinson and Ray; and Vilmorin, in 1883, says it can be so used, but this use now is probably very infrequent.

Caraway is called, in France, *carvi, anis des Vosges, cumin des pres;* in Germany, *Kummel;* in Holland, *karvii;* in Denmark, *kommen;* in Italy, *carvi;* in Spain, *carvi, alcaravea;* in Portugal, *alcaravia;*[2] in Arabic, *karaoweh,*[3] or *curweeya.*[4]

CARDOON. *Cynara cardunculus* L.

The cardoon is indigenous in the Mediterranean region, but has become naturalized elsewhere, as in Banda Oriental, where several hundred square miles have become covered by one mass of these prickly plants, and are impenetrable by man or beast.[5] The cultivated plant is little grown in England or in America, but in France, Italy, and generally in Europe the stalks and inner leaves, rendered white and tender by blanching, are in esteem. To the ancient Romans it was well known and cultivated for the footstalks, as at present.[6] Pliny[7] complains of the great price that monstrous-grown specimens brought at Rome, and that especially fine varieties came from Carthago and Corduba, in Spain. In more recent times, Ruellius,[8] in 1536, speaks of the use of the herb as a food, after the manner of

[1] Pharmacographia, 1879, 304.
[2] Vilmorin, Les Pl. Pot., 72.
[3] Delile, Fl. Ægypt, illust.
[4] Birdwood, Veg. Prod. of Bombay, 39, 237.
[5] Darwin, Voy. of a Nat., i. 153.
[6] Targioni-Tozzetti, Hort. Trans., 1854, 142.
[7] Pliny, lib. xix. c. 43.
[8] Ruellius, De Nat. Stirp., 1536, 643.

asparagus. Matthiolus,[1] in 1558, says there are many varieties in the gardens which are commonly called *Cardoni* by the Hetruscans, and that, diligently cultivated, these are tender, crisp, and white, and are eaten with salt and pepper. In 1623 Bauhin[2] calls the plant *Cinara spinosa, cujus pediculi esitantur.*

Vilmorin[3] describes five varieties,—the *Cardon de Tours*, the *Cardon plein inerme*, the *Cardon d'Espagne*, the *Cardon Puvis*, and the *Cardon à cotes rouges.*

The first of these, the *Cardon de Tours*, is very spiny, and we may reasonably believe it to be the sort figured by Matthiolus[4] in 1598, under the name of *Carduus aculeatus.* It is named in French works on gardening in 1824, 1826, 1829, etc.[5] Its English name is *Prickly Solid Cardoon;* in Spain it is called *Cardo espinoso.* It holds the first estimation with the market-gardeners of Tours and Paris.

The *Cardon plein inerme* is scarcely spiny, is a little larger than the preceding, but otherwise closely resembling. J. Bauhin[6] had never seen spineless cardoons. It is spoken of in 1824, in French books on gardening. It is called, in English, *Smooth-Solid Cardoon*, and has also names in Germany, Italy, and Spain.

The *Cardon d'Espagne* is very large and not spiny, and is principally grown in the southern portions of Europe. We may reasonably speculate that this is the sort named by Pliny as coming from Corduba. "Cardons d'Espagne" have their cultivation described in "Le Jardinier Solitaire," 1612. A "Spanish cardoon" is described by Townsend[7] in England in 1726, and the same name is used by McMahon[8] in America in 1806. It is the *Cynara integrifolia* of Vahl.

The *Cardon Puvis*, or *Artichoke-leaved*, is spineless, and is grown largely in the vicinity of Lyons, France. It finds mention in the French books on gardening of 1824, 1829, etc., as previously enumerated.

The *Cardon à cotes rouges*, or *Red-stemmed*, is so named from having the ribs tinged with red. It is called a recent sort by Burr in 1863.

[1] Matthiolus, Com., 1558, 322.
[2] Bauhin, Pin., 1623, 383.
[3] Vilmorin, Les Pl. Pot., 1883, 59.
[4] Matthiolus, Op., 1598, 496.
[5] L'Hort. Fran., 1824; Petit, Dict. du Jard., 1826; Noisette, Man., 1829.
[6] J. Bauhin, Hist., 1651, 50.
[7] Townsend, Seedsman, 1726, 29.
[8] McMahon, Am. Gard. Kal., 1806.

From a botanical point of view we have two types in these plants,—the armed and the unarmed; but these characters are by no means to be considered as very constant, as in the Smooth-Solid we have an intermediate form. In an olericultural point of view we have but one type throughout, but a greater or less perfection. A greater acquaintance with the wild forms would, doubtless, show to us the prototypes of the variety differences as existing in nature.

The cardoon is called, in France, *cardon*, *cardonette*, *chardonnerette*, *chardonnette;* in Germany, *Cardy*, *Carde;* in Flanders, *kardoen*, *cardonzen;* in Denmark, *kardon;* in Italy, Spain, and Portugal, *cardo.*

CARROT. *Daucus carota* L.

The carrot and the parsnip, if known to them, seem to have been confounded in the descriptions by the ancients, and we find little evidence that the cultivated carrot was known to the Greek writers, to whom the wild carrot was certainly known.[1] The ancient writers usually gave prominence to the medical efficacy of herbs; and if our supposition be correct that their carrots were of the wild form, we have evidence of the existence of the yellow and red roots in nature, the prototypes of these colors now found in our cultivated varieties. Pliny,[2] who was a naturalist, says they cultivate a plant in Syria like *staphylinos*, the wild (?) carrot, which some call *gingidium*, yet more slender and more bitter, and of the same properties, which is eaten cooked or raw, and is of great service as a stomachic; also a fourth kind, resembling a pastinaca somewhat, called by us *Gallicam*, but by the Greeks *daucon.* This comparison with a parsnip and the name is suggestive of the cultivated carrot. Galen, a Greek physician of the second century, implies cultivation of the carrot when he says the root of the wild carrot is less fit to be eaten than that of the domestic.[3] In the thirteenth century, however, Albertus Magnus (lib. vii. tract. ii. cap. 1–4) treats of the plants under field culture, garden culture, orchard culture, and vineyard culture, and yet, while naming the parsnip, makes no mention of the carrot,—if the word *pastinaca* really means the parsnip. I am willing to believe, however, that the *pastinaca* of Albertus

[1] Theophrastus, Bodæus a Stapel, ed. 1644, 1119, 1122.

[2] Pliny, lib. xx. c. 16; lib. xix. c. 27.

[3] Matth., Op., 1598, 570.

Magnus is the *carrot*, for in the sixteenth century Ammonius[1] gives the name for the carrot *pastenei*, as applying to *Pastinaca sativa* and *agrestis*. Barbarus, who died in 1493, and Virgelius[2] both describe the carrot under the name Pastinaca; and Apicius,[3] a writer on cookery in the third century, gives directions for preparing the *Carota* seu *pastinaca*, which can only apply to the *carrot*. Dioscorides[2] uses the word *Carota* as applying to the *Pastinaca silvestris* in the first century. Columella[4] and Palladius[5] both mention the *pastinaca* as garden plants, but say nothing but what can better apply to the carrot than the parsnip. Macer Floridus[6] also treats of what may be the *carrot* under *Pastinaca*, and says no roots afford better food.

We hence believe that the carrot was cultivated by the ancients, but was not a very general food-plant, and did not attain the modern appreciation; that the word *pastinaca*, or *cariotam*, or *carota*, in these times was applied to both the cultivated and the wild form; and we suspect that the word *Gallicam*, used by Pliny in the first century, indicates that the cultivated root reached Italy from France, where now it is in such exaggerated esteem.

The *Sisaron* of Dioscorides and the *Siser* of Columella and Pliny may have been a form of the carrot, but we can attain no certainty from the descriptions. The fact that the grouping of the roots which occurs in the Skirret, into which authors translate Siser, is not mentioned by the ancients,—a distinction almost too important to be overlooked,—and that the short carrot was called *Siser* by botanists of the sixteenth century, are arguments in favor of the Siser being a carrot. On the other hand, we should scarcely expect a distinction being made between *Pastinaca* and *Siser*, were both as resembling in the plant as are the two forms of carrot at present.

The carrot is now found under cultivation and as an escape throughout a large portion of the world. In China it is noticed in the Yuan dynasty, as brought from Western Asia, 1280–1368,[7] and is classed as a kitchen vegetable in the sixteenth, seven-

[1] Ammonius, Med. Herb., 1539, 186.
[2] In Ruellius's Dioscorides, 1529, 174.
[3] Apicius, lib. iii. c. 21.
[4] Columella, lib. xi. c. 3.
[5] Palladius, lib. c. 24.
[6] Macer Floridus, De Viribus Herb., l. 1284, Sillig ed., 1832; Æmelius Macer, Pictorius ed., 1581, 95, but a parsnip figured by Pictorius.
[7] Bretschneider, On the Study, etc., 17.

teenth, and eighteenth centuries by various Chinese authors.[1] In India the carrot is said to have first come from Persia, and now cultivated in abundance in the Mahratta and Mysore countries.[2] The carrot is enumerated among the edible plants of Japan by Thunberg,[3] and earlier by Kaempfer.[4] The kind now described by a Japanese authority[5] are an inch and a half in diameter at the crown and nearly two feet and a half long, of a high color. It is now cultivated in the Mauritius, where it has also become spontaneous.[6] It is recorded in Arabia by Forskål,[7] and was seen growing—both the yellow and the red—by Rauwolf at Aleppo in the sixteenth century.[8] In Europe its culture was mentioned by nearly all the ancient herbalists and by writers on gardening subjects, the red or purple kind finding mention by Ruellius[9] in 1536. In England the yellow and dark red, both long forms, are noticed by Gerarde[10] in 1597, and the species is supposed to have been introduced by the Dutch in 1558.[11] In the "Surveyors' Dialogue," 1604, it is stated that carrot-roots are then grown in England, and sometimes by farmers.[12] In the New World carrots are mentioned at Margarita Island by Hawkins in 1565[13] (and this implies that they were well known in England at this date); are mentioned in Brazil by Nieuhoff in 1647;[14] in Virginia in 1609[15] and 1648;[16] and in Massachusetts in 1629.[17] In 1779 carrots were among the Indian foods destroyed by General Sullivan near Geneva, N. Y.[18] So fond of carrots are the Flathead Indians, of Oregon, that the children cannot forbear stealing them from the fields, although honest as regards other articles.[19]

The types of the modern carrot are the tap-rooted and the premorse-rooted, with quite a number of sub-types, which are

[1] Bretschneider, Bot. Sin., 59, 83, 85; also Smith, Mat. Med., 51.
[2] Ainslie, Mat. Med., i. 57.
[3] Thunberg, Fl. Jap., xxxiii. 117.
[4] Kaempfer, Amœn., 1712, 822.
[5] Kizo Tamari, Comm. to New Orleans Expos., Am. Hort., September, 1886, 9.
[6] Bojer, Hort. Maurit., 160.
[7] Forskål, Fl. Æg.-Arab., xciii.
[8] Gronovius, Orient., 32.
[9] Ruellius, De Nat. Stirp., 1536, 699.
[10] Gerarde, Herbal, 1597, 872.
[11] Booth, Treas. of Bot.
[12] Gard. Chron., 1853, 346.
[13] Hawkins, Voy. Hak. Soc., ed. 27.
[14] Nieuhoff, Hak. Voy.
[15] A True Decl. of Va., 1610, 13.
[16] A Perf. Descr. of Va., 1649, 4.
[17] Higginson, Mass. Hist. Soc. Coll., 1st ser., i. 118; Wood, New Eng. Prosp., 1st ed., ii.
[18] Conover, Early Hist. of Geneva, 47.
[19] Pacific R. R. Rept., i. 295.

very distinct in appearance. The synonymy in part is as below. First, for the sharp-pointed forms, which are ancient,—

I. *The long, taper-pointed forms.*

Pastinaca sativa prima. Fuch., 1542, 682 (very little improved).
Moren. Roszlin, 1550, 106.
Staphylinus. Tragus, 1552, 442.
Carota. Cam. Epit., 1586, 509 (very highly improved); Matth., 1598, 549.
Pastinaca sativa Diosc. Daucus Theophrasti. Lob. ic., 1591, i. 720.
Pastinaca sativa atrorubens. Lob. ic., l. c., 723.
Pastinaca sativa tenuifolia. Ger., 1597, 872.
Pastinaca tenuifolia sativa. Dod., 1616, 678.
Pastinaca sativa rubens. Dod., 1616, 678.
Long yellows, reds, and whites of modern growing.

II. *The half-long, taper-pointed forms.*

? Pastinaca sativa altera. Fuch., 1542, 683 (very poor).
Siser. Matth. Com., 1558, 242; Pin., 1561, 147.
Siser alterum. Cam. Epit., 1586, 227.
Carota. Cast. Dur., 1617, 95.
Blanche des Vosges. Vilmorin, 1883, 70.
Danvers half-long of American gardens.

The premorse forms offer a number of sub-types which are very distinct, some being nearly spherical, others cylindrical, and yet others tapering, but all ending abruptly at the base, the tap-root starting from a flat, or nearly flat, surface. Their appearance seems to be modern.

I. The *spherical.* The earliest mention I find of this type is in France in 1824, 1826, and 1829,—the *Courte de Pollande.*[1] It is figured by Decaisne & Naudin,[2] and, in a more improved form, by Vilmorin in 1883.[3]

II. The *cylindrical.* The carrots of this type are remarkably distinct, and have for types the Carentan and the Coreless of Vilmorin. The first was in American seed-catalogues in 1878.

III. The *tapering.* Quite a number of varieties belong to this class, of which the Early Horn is the type. This was mentioned for American gardens by McMahon[4] in 1806, and by succeeding authors.

[1] L'Hort. Fran., 1824; Petit, Dict. du Jard., 1826; Noisette, Man., 1829.
[2] Decaisne & Naudin, Man., iv. 125. [3] Vilmorin, Les Pl. Pot., 1883, 62.
[4] McMahon, Am. Gard. Cal., 1806, 313.

In view of the confusion in early times in the naming of the carrot, it is desirable to offer a list of the names used by various authors, with the dates. The first, or long carrot, was called, in England, *carrot*, Lyte, 1586; in France, *carota*, Ruel., 1536, *carrottes, pastenades*, Pin., 1561, *pastenade jaulne, pastenade rouge*, Lyte, 1586, *carotte, racine jaulne*, Ger., 1597; in Germany, *Pastenei*, Ammon., 1539, *Pastiney, Pastinachen*, Fuch., 1542, *geel Ruben, rohte Ruben, weissen Ruben*, Trag., 1552, *Mohren*, Rosz., 1550, *Moren*, Pin., 1561, *gelbe Ruben, weissen Ruben*, Rauwolf, 1582, *rot Mohren, weisse Mohren*, Cam., 1586; in Dutch, *geel peen, pooten, geel mostilen, caroten*, Lyte, 1586; in Italy, *carota*, Pin., 1561, *carota* and *carotola*, Cam., 1586, *pastinaca*, Ger., 1597, Dod., 1616; in Spain, *canahoria*, Ger., 1597, and *pastenagues, cenoura*, Dod., 1616.

The half-long, taper-pointed carrot was called *Siser* by Matthiolus in 1558; in French, *carottes blanche*, Pin., 1561; but his other names applicable to the Skirret are the *chervy, giroles* aut *carottes blanches*, Cam. Epit., 1586; in Germany, *Gierlin* sive *Girgellin*, Cam., 1586; in Italy, *carota bianca*, Cam., 1586, *carotta, carocola*, Cast. Dur., 1617; in Spain, *chirivias*, Cam., 1586, who says planted in gardens and even in fields throughout Germany and Bohemia.

The modern names for the carrot, in Europe, are, in France, *carotte, faux-chervis, girouille, pastenade;* in Germany, *Mohre, Gelbrube, Carotte;* in Flanders, *wortel;* in Holland, *wortel, peen;* in Denmark, *guleroden;* in Italy, *carota;* in Spain, *zanahoria;* in Portugal, *cenoura;*[1] in Greece, *karotta*, or *staphulona*.[2]

In extra-European countries: in Arabic, *gezar*,[3] *istufleen, juzir-ul-bostanee;* in Bengali, *gajar;* in Egypt, *djazar;* in India, *gager;*[4] in Japan, *kofuk*, vulgo *nisji* et *jabu nensin;*[5] in Persia, *zardak;* in Sanscrit, *grinjuna, canjara;* in Telugu, *gazeragedda*.

The various forms of the carrot have probably their prototypes in nature, but as yet the evidence is a little deficient. We may suspect the general resemblance of the *Altringham* to the Japanese variety already mentioned may be somewhat more than accidental, and to signify the original introduction of this variety from Japan. We have, in the attempts at amelioration, noted

[1] Vilmorin, l. c., 60.
[2] Pickering, Ch. Hist., 190.
[3] Delile, Fl. Ægypt, illust.
[4] Birdwood, Veg. Prod. of Bomb., 162.
[5] Kaempfer, Amœn., 1712, 822; Thunb., Jap., 117.

the appearance of forms of similar types as those under cultivation.[1] The presumptive evidence is in favor of the view that all cultivated types are removes from nature, not new originations by man; yet the proof is not as decisive as could be wished.[2]

(To be continued.)

REVIEW OF THE PROGRESS OF NORTH AMERICAN PALÆONTOLOGY FOR THE YEAR 1886.

BY JOHN BELKNAP MARCOU.

THE year which has just passed has been fairly prolific in palæontologic works and promises well for the future of American palæontology. With the exception of the death of the veteran palæontologist and conchologist, Isaac Lea, of Philadelphia, we have to deplore the loss of no eminent workers in this branch of science.

I have extended this review so as to include the vertebrates, which I had not touched in my similar work for previous years, and, although my slighter acquaintance with the subject has made it much more difficult for me to get the material together, I trust that it will be found a welcome addition by those interested in this branch of the science.

T. H. Aldrich publishes a "Preliminary Report upon the Tertiary Fossils of Alabama and Mississippi" in the *Geol. Sur. Alabama*, Bull. No. 1, p. 18. In the *Jour. Cincinnati Soc. Nat. His.*, vol. viii. p. 256, he has "Notes on the Distribution of Tertiary Fossils in Alabama and Mississippi."

J. A. Allen has an article "On an Extinct Type of Dog from Ely Cave, Lee County, Va.," in the *Mem. Mus. Comp. Zool.*, at Harvard College, vol. x. p. 1. Professor Shaler appends a note, from which one would infer that he considers the remains described to be of Pliocene age.

H. M. Ami, in the *Canad. Rec. Sci.*, vol. ii. p. 304, has a note "On the Occurrence of *Scolithus* in Rocks of the Chazy Formation about Ottawa, Ontario."

Charles A. Ashburner and Angelo Heilprin have, in the *Proc.*

[1] Joigneaux, Traite des Graines, 44.

[2] See Proc. of Soc. for P. of Agr. Sc., 1886, p. 68, for an article of mine on this subject.

and Collections Wyoming His. and Geol. Soc., vol. ii. p. 254, an article entitled "Report on the Wyoming Valley Carboniferous Limestone Beds, by C. A. Ashburner, Geologist in Charge of the Anthracite Survey, and Corresponding Member of the Wyoming Historical and Geological Society, accompanied by a Description of the Fossils contained in the Beds, by Angelo Heilprin."

L. W. Bailey has a "Report of Explorations and Surveys in Portions of the Counties of Carleton, Victoria, York, and Northumberland, New Brunswick, 1885," in the *Ann. Report Geol. and Nat. Surv. Canada*, new ser., vol. i. pp. 18–309.

Mariano Barcena, in the AMERICAN NATURALIST, vol. xx. p. 633, has a note on "The Fossil Man of Peñon."

W. H. Barris, in the *Proc. Davenport Acad. Nat. Sci.*, vol. v. p. 15, criticises a paper on the "Geology of Scott County, Iowa, and Rock Island County, Ill., by A. S. Tiffany."

G. Baur, in the *Morphologisches Jahrbuch*, Band xii. Heft 11, p. 299, has an article entitled "Ueber die Kanale im Humerus der Amnioten." In the *Biologisches Centralblatt*, Band vi. p. 353, he has "Ueber die Morphogenie der Wirbelsäule der Amnioten."

J. P. Bishop gives a notice "On Certain Fossiliferous Limestones of Columbia County, N. Y., and their Relation to the Hudson River Shales and the Taconic System" in the *Amer. Jour. Sci.*, 3d ser., vol. xxxii. p. 438.

F. Brauer, in the *Annalen des k.k. Naturhistorischen Hofmuseums*, redigirt von Franz Ritter von Hauer, Band i. No. 2, p. 87, criticises some of S. H. Scudder's works in an article entitled "Ansichten über die paläozoischen Insecten und deren Deutung."

W. C. Brögger, in an article called "Om alderen af Olenelluszonen i Nordamerika," Geol. Forenings i Stockholm Forhand, No. 101, Bd. viii. H. 3, p. 182, attempts to prove that the Olenellus beds are older than the Paradoxides beds.

R. E. Call has an article "On the Genus *Campeloma Rafinesque*, with a Revision of the Species, Recent and Fossil," in the *Bull. Washburn College Laboratory Nat. His.*, vol. i. No. 5, p. 159.

E. Canu has an article on "L'articulé problématique des dépôts tertiaires de Florrisant; *Planocephalus aselloides* Scudder," in the *Soc. Geol. du Nord. Annales*, vol. xii. p. 148.

P. H. Carpenter has a "Note on the Structure of Crotalocrinus" in the *Ann. and Mag. Nat. His.*, 5th ser., vol. xviii. p. 397.

R. Chalmers has a "Preliminary Report on the Surface Geology of New Brunswick" in the *Ann. Report Geol. and Nat. His. Surv. Canada*, new ser., vol. i. p. 1, gg.

E. W. Claypole, in the *Proc. and Coll. Wyoming Hist. and Geol. Soc.*, vol. ii. pt. 2, p. 239, has a "Report on Some Fossils from the Lower Coal-Measures near Wilkesbarre, Luzerne County, Pa."

E. A. Congdon has "Remarks upon a Deposit of Infusorial Earth on the South Shore of Clove Lake, Staten Island," in the *Proc. Nat. Sci. Assoc. Staten Island*, May 8, 1886.

E. D. Cope has "Second Continuation of Researches among the Batrachia of the Coal-Measures of Ohio" in the *Proc. Amer. Phil. Soc.*, vol. xxxii. p. 405. In the *Trans. Vassar Bro. Inst.*, vol. iii. pt. 1, p. 60, he has an address entitled "The Genealogy of the Vertebrata as learned from Palæontology." He has notes on "The Sternum of the Dinosauria;" "Corrections of Notes on the Dinocerata," in the AMERICAN NATURALIST, vol. xx. pp. 153 and 155. In the *Geol. Mag.*, new ser., Decade iii. vol. iii. p. 49, is an article entitled "Prof. E. D. Cope on a New Type of Perissodactyle Ungulate from the Wasatch Eocene of Wyoming Territory, United States of America;" on p. 141 of the same magazine he has a note on "Edestus and Pelecopterus." In the AMERICAN NATURALIST, vol. xx. p. 367, he has a note on "The Vertebrate Fauna of the Ticholeptus Beds;" on p. 451 he has an article on "The Plagiaulacidæ of the Puerco Epoch." In the *Geol. Mag.*, new ser., Decade iii. vol. iii. p. 238, he has "Notes on Phenacodus;" on p. 239 he has a "Note on Erisichthe." He has a report on the "Vertebrata of the Swift Current Creek Region of the Cypress Hills" in the *Ann. Rep. Geol. and Nat. Hist. Surv. Canada*, 1885, published May, 1886. He has a note on "The Long-spined Theromorpha of the Permian Epoch" in the AMERICAN NATURALIST, vol. xx. p. 544; on p. 611 he has an article on "The Phylogeny of the Camelidæ;" on p. 1027 he has "An interesting Connecting Genus of Chordata;" on p. 1044 he describes "A Giant Armadillo from the Miocene of Kansas." In the *Trans. Amer. Philos. Soc. Philad.*, vol. xii., 2d ser., p. 243, he has an article "On the Intercentrum of the Terrestrial Vertebrata." He also published a book on "The Origin of the Fittest, Essays on Evolution," published in New York. In the *Trans. Am. Phil. Soc.*, vol. xvi. p. 285, he has a "Systematic Catalogue of Species of Vertebrata found in the Beds of the Permian Epoch in North America, with Notes and Descriptions." In the *Proc. Amer. Phil. Soc.* for 1885, p. 234, he has an article "On the Structure of the Brain and Auditory Apparatus of a Theromorphous Reptile of the Permian Epoch."

F. W. Cragin has "Notes on the Geology of Southern Kansas" in the *Bull. Washburn College Laboratory Nat. Hist.*, vol. i. No. 3, p. 85.

K. M. Cunningham, in *Science*, vol. vii. p. 35, calls attention to a "New Find of Fossil Diatoms."

T. Nelson Dale, in the *Proc. Canadian Inst.*, 3d ser., vol. iv. p. 69, has a note on "New England Upper Silurian."

James D. Dana, in the *Proc. A. A. A. Sci.*, vol. xxxiv. p. 216, and in the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 241, has an article "On Lower Silurian Fossils from a Limestone of the Original Taconic of Emmons." In the *Amer. Jour. Sci.*, 3d ser., vol. xxxii. p. 236, he has a note on "The Taconic Stratigraphy and Fossils."

Nelson H. Darton, in *Sci.*, vol. vii. p. 78, has a note entitled the "Taconic Controversy in a Nutshell." In the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 209, he has an article "On the Area of Upper Silurian Rocks near Cornwall Station, Eastern Central Orange County, N. Y."

W. Davies, in the *Geol. Mag.*, new ser., Decade iii. vol. iii. p. 141, has a "Note on Prof. E. D. Cope's article upon Edestus and Pelecopterus, etc."

Sir J. W. Dawson has an abstract of a paper "On the Fossil Flora of the Laramie Series of Western Canada" in the AMERICAN NATURALIST, vol. xx. p. 635, and in the *Amer. Jour. Sci.*, 3d ser., vol. xxxii. p. 242. In the *Geol. Mag.*, new ser., Decade iii. p. 503, he has an abstract of a paper "On Canadian Examples of Supposed Fossil Algæ."

William B. Dwight, in the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 125, has an article on "Recent Explorations in the Wappinger Valley Limestone of Dutchess County, N. Y., No. 5, Discovery of Fossiliferous Potsdam Strata at Poughkeepsie, N. Y.," and a note on this subject is also placed in the *Proc. A. A. A. S.*, vol. xxxiv. pt. 1, p. 204.

R. W. Ellis has a "Report on the Geological Formations of Eastern Albert and Westmoreland Counties, New Brunswick, and of Portions of Cumberland and Colchester Counties, Nova Scotia, embracing the Spring Hill Coal Basin and the Carboniferous System north of the Cobequid Mountains," in the *Geol. and Nat. Hist. Surv. Canada Ann. Rep.*, new ser., vol. i. p. 1 e.

Robert Etheridge, Jr., and P. Herbert Carpenter have published a "Catalogue of the Blastoidea in the Geological Department of the British Museum (Natural History), with an Account of the Morphology and Systematic Position of the Group and a Revision of the Genera and Species;" in this many American forms are described and discussed.

John Eyerman, in the *American Jour. Sci.*, 3d ser., vol. xxxi. p. 72, has a note on "Footprints on the Triassic Sandstone (Jura-Trias) of New Jersey."

Charles L. Faber has some "Remarks on Some Fossils of the Cincinnati Group" in the *Jour. Cincinnati Soc. Nat. Hist.*, vol. ix. p. 14.

H. Filhol has "Observations sur le mémoire de M. Cope intitulé Relations des Horizons renfermant des débris d'animaux vertébrés Fossiles en Europe et en Amérique" in the *Ann. Sci. Geol.*, vol. xvii. p. 1.

S. W. Ford has "Notice of a New Genus of Lower Silurian Brachiopoda," and "Note on the recently proposed Genus Billingsia," in the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 466, and vol. xxxii. p. 325. He has also published a "Note on the Age of the Swedish Paradoxides Beds" in the *Amer. Jour. Sci.*, 3d ser., vol. xxxii. p. 473. In connection with W. B. Dwight he has published a "Preliminary Report of S. W. Ford and W. B. Dwight upon Fossils obtained in 1885 from Metamorphic Limestones of the Taconic Series of Emmons, at Canaan, N. Y. (A) Explanatory Statements with Reference to the Palæontological Investigations at Canaan, N. Y., by W. B. Dwight. (B) Joint Report on the Fossils" in the *American Jour. Sci.*, 3d ser., vol. xxxi. p. 248.

A. F. Foerste describes the fossils of "The Clinton Group of Ohio" in the *Bull. Sci., Laboratories Denison University*, vol. i. p. 63.

C. E. Grant and Sir J. W. Dawson have "Notes on Pleistocene Fossils from Anticosti" in the *Can. Rec. Sci.*, vol. ii. p. 44.

L. P. Gratacap has a note on "Fish Remains and Tracks in the Triassic Rocks at Weehawken, N. J.," in the AMERICAN NATURALIST, vol. xx. p. 243.

James Hall has "Bryozoa of the Upper Helderberg Group, Plates and Explanations. Published in advance of the Report of the State Geologist for 1886, and of vol. vi., Pal. N. Y., 1886, pls. i.–xii. pp. 1–29. Albany, 1886."

F. L. Harvey has a note "On *Anthracomartus trilobitus* Scudder" in the *Proc. Acad. Nat. Sci. Philada.*, p. 231, September, 1886.

Angelo Heilprin has "Notes on the Tertiary Geology and Palæontology of the United States" in the *Proc. Acad. Nat. Sci.*, p. 57, March, 1886, Philadelphia. In the *Trans. Wagner Free Institute Sci.*, p. 65, Philad., 1886, he has "Explorations on the West Coast of Florida and in the Okeechobee Wilderness, with Special Reference to the Geology and Zoology of the Floridian Peninsula. A Narrative of Researches undertaken under the Auspices of the Wagner Free Institute of Science of Philadelphia." Many new species without illustrations are described in this paper. He has also a note "On Miocene Fossils from Southern New Jersey" in the *Proc. Acad. Nat. Sci. Philad.*, p. 351, December, 1886.

L. E. Hicks has a note on "The Permian in Nebraska" in the AMERICAN NATURALIST, vol. xx. p. 881.

E. W. Hilgard has a note on "Dr. Otto Meyer and the Southwestern Tertiary" in *Science*, vol. vii. p. 11. In the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 398, is an abstract of a paper entitled "Making Deposits of the Remains of Birds, Squirrels, and other Small Animals," from William's "Mineral Resources of the United States for the Years 1883–4."

Franklin C. Hill has an article "On the Mounting of Fossils" in the AMERICAN NATURALIST, vol. xx. p. 353.

G. J. Hinde, in *Ann. and Mag. Nat. Hist.*, p. 271, March, 1886, has an article on "*Hystricrinus* Hinde versus *Arthroacantha* Williams, a Question of Nomenclature."

Arthur Hollick publishes "Remarks on Some Fossil Leaves from Kreischerville and New Jersey" in the *Proc. Nat. Sci. Assoc. Staten Island*, February 13, 1886.

Joseph F. James has "Cephalopoda of the Cincinnati Group;" "Description of a New Species of Gomphoceras from the Trenton of Wisconsin;" and "Note on a Recent Synonyme in the Palæontology of the Cincinnati Group," in the *Jour. Cin. Soc. Nat. Hist.*, vol. viii. pp. 235 and 255, and vol. ix. p. 39.

T. Rupert Jones has an article "On Palæozoic Phyllopoda," and one "On Some Fossil Ostracoda from Colorado," in the *Geol. Mag.*, new ser., Decade iii. vol. iii. pp. 456 and 145.

Geo. F. Kunz has an article on "Agatized and Jasperized Wood of Arizona" in the *Pop. Sci. Monthly*, vol. xxviii. p. 362.

G. W. Lamplugh, in the *Quart. Jour. Geol. Soc. London*, vol. xlii. pt. 3, p. 276, has an article "On Glacial Shell Beds in British Columbia."

D. W. Langdon publishes "Observations on the Tertiary of Mississippi and Alabama, with Descriptions of New Species," in the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 202.

Joseph Leidy has "Mastodon and Llama from Florida;" "An Extinct Boar from Florida;" and "Caries in the Mastodon," in *Proc. Acad. Nat. Sci. Phila.*, pp. 11, 37, and 38, March, 1886.

Lennox has a note on "The Fossil Sharks of the Devonian" in the *Proc. Canadian Inst.*, 3d ser., vol. iii. p. 120.

Richard Lydekker has published "Catalogue of the Fossil Mammalia in the British Museum (Natural History), Cromwell Road S. W., part iii., containing the Order Ungulata, suborders Perissodactyla, Toxodontia, Condylarthra, and Amblypoda." This contains many American species.

A. McCharles has published a paper entitled "The Extinct Cuttle-Fish in the Canadian Northwest. A Paper read before the Canadian Institute, Toronto, March 4, 1885."

John Belknap Marcou has published "Department of the Interior, U. S. National Museum, Serial No. 40, *Bulletin of the United States National Museum*, No. 30, published under the direction of the Smithsonian Institution. Bibliographies of American Naturalists, III. Bibliography of Publications relating to the collection of Fossil Invertebrates in the United States National Museum, including Complete Lists of the Writings of Fielding B. Meek, Charles A. White, and Charles D. Walcott. Washington, 1885." Four hundred copies of an extract from this were published under the title "Annotated Catalogue of the Published Writings of Charles Abiathar White, 1860–1885. Extracted from *Bull. 30, U. S. National Museum*, pp. 11–181, 1885." In the *Proc. U. S. Nat. Mus.*, vol. ix. p. 250, he has a "Supplement to the List of Mesozoic and Cenozoic Invertebrate Types in the Collections of the National Museum." In the American Naturalist, vol. xx. p. 505, he has a "Review of the Progress of North American Invertebrate Palæontology for 1885;" and, finally, a "Record of North American Invertebrate Palæontology for the Year 1885, from the Smithsonian Report for 1885. Washington, 1886."

George F. Matthew has "Illustrations of the Fauna of the St. John Group continued, No. 3. Descriptions of New Genera and Species (including a Description of a New Species of Solenopleura, by J. F. Whiteaves)," in the *Proc. and Trans. Roy. Soc. Canada* for the year 1885, vol. iii. section iv. p. 29. He has a "Synopsis of the Fauna in Division 1, of the St. John Group, with Preliminary Notes on the Higher Faunas of the same Group;" in the *Bull. Nat. His. Soc. New Brunswick*, No. 5, p. 25, he publishes a note on "The Structural Features of *Discina acadica* (Hartt) of the St. John Group," and one on the "Discovery of a Pteraspidian Fish in the Silurian Rocks of New Brunswick," in the *Canadian Rec. Sci.*, vol. ii. No. 1, p. 9, and No. 4, p. 251. In the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. pp. 72 and 472, he has a "Pteropod of the St. John Group (from a Letter by Mr. G. F. Matthew, dated St. John, New Brunswick, December 8)," and a "Note on the Occurrence of *Olenellus kjerulfi* in America." He has an "Additional Note on the Pteraspidian Fish found in New Brunswick" in the *Canad. Rec. Sci.*, vol. v. No. 5, p. 323.

Otto Meyer and T. H. Aldrich have published in the *Jour. Cin. Soc. Nat. His.*, vol. ix. p. 40, an article on "The Tertiary Fauna of Newton and Wautubbee, Miss."

Otto Meyer, in the *Geol. Sur. Alabama*, Bull. No. 1, pt. 2, p. 63, has "Contributions to the Eocene Palæontology of Alabama and Mississippi." In the *Amer. Jour. Sci.*, 3d ser., vol. xxxii. p. 20, he has "Observations on the Tertiary and Grand Gulf of Mississippi." In the AMERICAN NATURALIST, vol. xx. p. 637, he has "Notes on the Variation of Certain Tertiary Fossils in Overlying Beds."

Fred. K. Mixer and Herbert U. Williams have a note on "Fish Remains from the Corniferous near Buffalo" in the *Bull. Buffalo Soc. Nat. Sci.*, vol. v. p. 84.

D. R. Moore has an article on "Fossil Corals of Franklin County, Indiana," in the *Bull. Brookville Soc. Nat. His.*, No. 2, p. 50; and in No. 1, p. 44, he has "Two Hours among the Fossils of Franklin County, Ind."

Charles Morris has an article on "Methods of Defence in

Organisms" in the *Proc. Acad. Nat. Sci. Philada.*, p. 25, March, 1886.

J. S. Newberry, in the *Bull. Torrey Botanical Club*, vol. xiii. pp. 33 and 77, has "The Flora of the Amboy Clays," and "Description of a Species of Bauhinia from the Cretaceous Clays of New Jersey." In the *Trans. N. Y. Acad. Sci.*, vol. v. p. 133, he has an abstract of a paper on "The Cretaceous Flora of North America, Illustrated by Drawings and Lantern Views."

H. Allyne Nicholson has an article "On Some New or Imperfectly-known Species of Stromatoporoids" in *Ann. and Mag. Nat. Hist.*, 5th ser., vol. xviii. p. 8, London. Several American species are described. He has also published "A Monograph of the British Stromatoporoids, pt. 1, General Introduction. The Palæontological Society, Instituted 1847, vol. for 1885. London, 1886."

Henry F. Osborn has "A New Mammal from the American Triassic" in *Science*, vol. viii. p. 540. In the *Proc. Acad. Nat. Sci.*, p. 359, December, 1886, he has "Observations upon the Upper Triassic Mammals, Dromatherium and Microconodon."

Richard Owen has an article "On a New Perissodactyle Ungulate from Wyoming" in the *Geol. Mag.*, new series, Decade iii. vol. iii. p. 140.

A. S. Packard has an article on "Geological Extinction and some of its Apparent Causes," and on the "Discovery of Lamellate Thoracic Feet in the Phyllocarida" in the AMERICAN NATURALIST, vol. xx. pp. 29 and 155, and in the *Proc. Amer. Phil. Soc. Philad.*, vol. xxiii. p. 380.

J. Hayes Panton has "Fragmentary Leaves from the Geological Records of the Great Northwest;" "Gleanings from the Geology of the Red River Valley;" "Gleanings from Outcrops of Silurian Strata in the Red River Valley;" and "Notes on the Geology of Some Islands in Lake Winnipeg," in the *Manitoba Hist. and Sci. Soc. Winnipeg Trans.*, Nos. 4, 3, 15, and 20.

Julius Pohlman has an article on "Fossils from the Waterlime Group near Buffalo, N. Y.," in the *Bull. Buffalo Soc. Nat. Sci.*, vol. v. p. 23.

F. W. Putnam has a note on the "Discovery of a Mastodon Skull at Shrewsbury" in the *Proc. Boston Soc. Nat. Hist.*, vol. xxiii. p. 242.

H. Rauff has a note "On the Genus Hindia Dunc." in the *Ann. and Mag. Nat. Hist.*, 5th ser., vol. xviii. p. 169.

Eugene N. S. Ringueberg has descriptions of "New Genera and Species of Fossils from the Niagara Shales" in the *Bull. Buffalo Soc. Nat. Sci.*, vol. v. p. 1.

C. Rominger has an article "On the Minute Structure of Stromatopora and its Allies" in the *Proc. Acad. Nat. Sci. Phila.*, p. 39, March, 1886.

Oscar Schmidt has published in the *International Scientific Series* "The Mammalia in their Relation to Primeval Times. New York, 1886;" this is a translation of his German work.

W. B. Scott has an article "On Some New Forms of Dinocerata" in the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 303.

S. H. Scudder, in the *Mem. Boston Soc. Nat. Hist.*, vol. iii. No. 13, pp. 431, 438, and 439, has "The Oldest Known Insect Larva, *Mormolucoides articulatus*, from the Connecticut River Rocks;" "Note on the supposed Myriopodan Genus Trichiulus;" and "A Review of Mesozoic Cockroaches." He has also published an article entitled "The Cockroach of the Past," reprinted from "The Structure and Life History of the Cockroach (*Periplaneta orientalis*), by L. C. Miall and Alfred Denny, pp. 205–219. London, 1886." In the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 310, he describes a "New Carboniferous Arachnidan from Arkansas." *Bull. U. S. Geol. Surv.*, No. 31, is a "Systematic Review of our Present Knowledge of Fossil Insects, including Myriapods and Arachnids;" this appeared first in German as a portion of "Zittel's Handbuch der Paleontologie," I. Abtheilung Paleozoologie, Bd. ii. p. 721.

H. M. Seely has a note on "The Genus Strephochetus, Distribution and Species," in the *Amer. Jour. Sci.*, 3d ser., vol. xxxii. p. 31.

N. S. Shaler has a "Preliminary Report on the Geology of the Cobscook Bay District, Maine. Published by permission of the Director of the U. S. Geol. Survey," in the *Amer. Jour. Sci.*, vol. xxxii. p. 35.

A. H. Smith has a note on "The Railway Cutting at Gray's Ferry Road" in the *Proc. Acad. Nat. Sci. Phila.*, p. 253, September, 1886.

M. Stirrup has an article "On Some Fossils from the Palæozoic Rocks of America, principally from the State of Indiana," in the *Manchester Geol. Soc. Trans.*, vol. xviii. p. 331.

T. Thorell has an article "On *Proscorpius osbornei* Whitfield" in the AMERICAN NATURALIST, vol. xx. p. 269.

A. S. Tiffany has a work on the "Geology of Scott County, Iowa, and Rock Island County, Ill., and the Adjacent Territory, showing the Geographical and Vertical Range of the Fossils of the Niagara Corniferous and Hamilton Groups of Rocks, and the Chemung Group at Burlington, Iowa, with Supplement. Davenport, Iowa, 1885."

E. O. Ulrich has "Descriptions of New Silurian and Devonian Fossils, Contributions to American Palæontology, vol. i. p. 3, May, 1886, Cincinnati." He has a "Report on the Lower Silurian Bryozoa, with Preliminary Descriptions of some of the New Species," and "Remarks upon the Names *Cheirocrinus* and *Calceocrinus*, with Descriptions of three New Generic Terms and one New Species," in the *14th Ann. Rep. Geol. and Nat. Hist. Surv. Minnesota*, pp. 57 and 104.

Charles Wachsmuth and Frank Springer have published "Revision of the Palæocrinoidea, Part III. Discussion of the Classification and Relations of the Brachiate Crinoids, and Conclusion of the Generic Descriptions, Second Section," in the *Proc. Acad. Nat. Sci. Phila.*, p. 65, March and September, 1886. The author's edition contains, in addition to the article in the *Proceedings*, an index of all generic and specific names used in connection with the Palæocrinoidea.

M. E. Wadsworth has a note "On a Supposed Fossil from the Copper-Bearing Rocks of Lake Superior" in the *Proc. Boston Soc. Nat. His.*, vol. xxiii. p. 208.

C. D. Walcott has an article on the "Classification of the Cambrian System of North America" in the *Amer. Jour. Sci.*, 3d ser., vol. xxxii. p. 138. He has also published a "Second Contribution to the Cambrian Faunas of North America," *Bull. 30, U. S. Geol. Surv.* Washington, 1886.

L. F. Ward has a "Note on a few Imperfect Leaf Impressions from Northern California" in *Bull. U. S. Geol. Surv.*, No. 33, p. 16. In the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 370, he has a note "On the Determination of Fossil Dicotyledonous Leaves."

C. A. White has published "On the Fresh Water Invertebrates of the North American Jurassic," *Bull. U. S. Geol. Surv.*, No. 29, Washington, 1886, and "On the Relation of the Laramie Molluscan Fauna to that of the Succeeding Fresh-Water Eocene and other Groups," *Bull. U. S. Geol. Surv.*, No. 34. Washington, 1886.

R. P. Whitfield has a reply to Professor Thorell's criticism, entitled "Professor Thorell and the American Silurian Scorpion," in *Science*, vol. vii. p. 216. He has published "Brachiopoda and Lamellibranchiata of the Raritan Clays and Greensand Marls of New Jersey," *Monographs of the U. S. Geol. Surv.*, vol. ix. Washington, 1885; this appeared also as a publication of the *Geol. Surv. of New Jersey*. Trenton, 1886. In the *Bull. Amer. Mus. Nat. Hist.*, vol. i. p. 293, he has a "Notice of Geological Investigations along the Eastern Shore of Lake Champlain, conducted by Prof. H. M. Seely and Presdt. Ezra Brainerd, of Middlebury College, with Descriptions of the New Fossils discovered by R. P. Whitfield." In the AMERICAN NATURALIST, vol. xx. p. 1041, he has a notice on the same subject. In the *Bull. Amer. Mus. Nat. Hist.*, vol. i. p. 346, he has also a "Notice of a New Fossil Body, probably a Sponge related to Dictyophyton."

H. S. Williams has a criticism of Prof. James Hall's "Palæontology," vol. v. part i., entitled "Devonian Lamellibranchiata and Species-making," in the *Amer. Jour. Sci.*, 3d ser., vol. xxxii. p. 192. In the *Proc. A. A. A. S.*, vol. xxxii. part i. p. 222, he has an article "On the Classification of the Upper Devonian."

H. N. Williams has "Notes on the Fossil Fishes of the Genessee and Portage Black Shales" in the *Bull. Buffalo Soc. Nat. Sci.*, vol. v. p. 81.

S. G. Williams has "Westward Extension of Rocks in the Lower Helderberg Period in New York" in the *Proc. A. A. A. S.*, vol. xxxiv. part i. p. 235, and "The Westward Extension of Rocks of Lower Helderberg Age in New York" in the *Amer. Jour. Sci.*, 3d ser., vol. xxxi. p. 139.

N. H. Winchell has a "Notice of Lingula and Paradoxides from the Red Quartzites of Minnesota, Abstract," in the *Proc. A. A. A. S.*, vol. xxxiv. part i. p. 214. "The Taconic Controversy in a Nutshell" in *Science*, vol. vii. p. 34. He describes "New Species of Fossils" in the *14th Annual Rep. Geol. and Nat. His. Surv. Minnesota* for the year 1884, p. 313, and gives a list of "Specimens Registered in the General Museum in 1885" on pp. 125–6.

A. Woodward has published "The Bibliography of the Foraminifera, Recent and Fossil, including Eozoon and Receptaculites, 1565–January 1, 1886," in the *14th Annual Rep. Geol. and Nat. Hist. Surv. Minnesota* for the year 1885, p. 167.

L. Woolman has a note on the "Oriskany Sandstone in Lycoming County, Pa.," in the *Proc. Acad. Nat. Sci. Philad.*, p. 296, September, 1886.

THE DIPNOAN BRAIN.[1]

BY BURT G. WILDER.

THIS paper includes an account of the brain of *Ceratodus* (*Neoceratodus* Gill), substantiated by photographs and preparations of three unusually well-preserved specimens in the Museum of Cornell University; an admission of the writer's own earlier errors in respect to the brains of "fishes," especially in disregarding the membranous portions of the cœlian parietes; a criticism of Huxley's paper in the *Zool. Soc. Proc.*, January 4, 1876 (the later paper of Beauregard does not discuss the *structure* of the brain); a tabular statement of the resemblances and differences between the Dipnoi and other groups, particularly the Plagiostomes and Amphibia; a reiteration of belief (*Am. Assoc. Proc.*, 1875, 189) in the paramount value of cardiac and encephalic characters for the discrimination of more comprehensive groups; a reference to the morphological significance of the *aula* or mesal division of the prosocœle; a list of points requiring further investigation.

The brain of *Ceratodus* agrees with that of *Protopterus* (as described and figured by Fulliquet in the *Recueil Zool. Suisse* for 1886, and as seen in a recent dissection by the writer) in the important point that *the prosencephal consists mainly of a pair of large lobes whose cavities* (*procœles or* "*lateral ventricles*") *are connected only by a comparatively small aula*, as in Amphibia and the higher vertebrates. Unlike *Protopterus*, however, between the dorsal parts of these lobes there is a *long and thick supraplex*, which, through an interruption of the proper nervous parietes for nearly the whole length, sends into each lobe a prolongation covered, like all plexes, by the lining endyma. In mammals,

[1] Abstract of a paper "On the Brain of *Ceratodus*, with Remarks upon Classification and the General Morphology of the Vertebrate Brain," read, by invitation, before the National Academy of Sciences, April 22, 1887.

birds, and reptiles such an interruption for plexal intrusion, when it exists, extends *caudad* from the porta or lateral orifice of the aula, and is known as the *rima* ("great transverse fissure" of anthropotomy). In *Ceratodus* alone, so far as known to the writer, is there a *prerima*,—that is, a rima extending *cephalad* from the margin of the porta. The brain examined by Huxley was evidently ill preserved; the supraplex was mistaken for a *tela vasculosa* (the writer's *aulatela*). Finally, it would appear that the margins of the rima on each side, after the supraplex was pulled out, were supposed to be artificial, so as to lead to the supposition that the dorsal portions of the cavities of the lateral lobes formed a single large "*ventriculus communis.*" In the writer's specimens the lobes are separated as high as the plexus by a firm, membranous *quasi-falx*, and the prosencephalic region of the cranial floor presents a distinct mesal ridge, which is absent in *Protopterus*. In *Ceratodus* the olfactory lobes are pedunculated instead of sessile, as in *Protopterus;* but in both genera (and apparently also in *Lepidosiren*) they lie in the plane of the general brain-axis, and the proper cerebral outgrowths are ventral in position instead of dorsal, as in the Amphibia, Reptiles, Birds, and Mammals. Among other features not before recorded of *Ceratodus* is the *precommissure* and a thick *valvula* reaching more than half-way to the floor of the encephalocœle (general cavity of the brain). The conarium is very large and saccular, and closely attached to the supraplex. As stated by Huxley, the tip of the conarium is lodged in a distinct depression (the conarial fossa) in the roof of the cranial cavity, and the mesencephal does not present any marked furrow between paired optic lobes. Of the resemblances from which Huxley concludes that, "in its cerebral [encephalic] characters, *Ceratodus* occupies a central place in the class Pisces" [Ichthyopsida, excluding Amphibia], some are trivial, others apply to more than one group, and others are founded upon errors of observation or interpretation. So far as the brain is concerned, *Ceratodus* has no near affinity with the Plagiostomes, much less with the Holocephals, Ganoids, Teleosts or Marsipobranchs. In the writer's opinion, the Dipnoi form a class coordinate with the Amphibia, with which, on the whole, they are most nearly allied. The heart needs further study, and the development is unknown.

In a shark, *Scymnus*, as figured by T. J. Parker (*New Zealand Inst. Trans.*, xv. 1882; *Nature*, December 30, 1886), each lateral portion of the prosencephal, between the unpaired part and the olfactory lobe, presents a fusiform and nearly symmetrical dilatation. In 1876 the writer called attention (*Am. Jour. Sci.*, xii. 105) to the fact that in the lamprey the only part which can be regarded as a cerebral hemisphere lies *laterad* of the olfactory lobe (caudad when the paired portions are at a right angle with the meson); also that in most sharks and rays the "hemisphere" projects on the *opposite side* of the olfactory crus, and usually unites with its platetrope (lateral homologue). In Dipnoi the cerebral outgrowth is *ventral*. In either of these directions in which what may be regarded as the special organ of the mind is projected among these low or generalized forms there would seem to be mechanical obstacles to any considerable expansion; but *dorsally* there is opportunity for comparatively unlimited extension, and it is in this direction that the hemispheres begin to develop in the Amphibia and attain such enormous growth in Birds and Mammals. This revolution, so to speak, of the hemisphere about the olfactory axis accords with other considerations which have led Spitzka and the writer independently to consider the prevailing idea that the olfactory lobes are mere appendages of the cerebrum as nearly the reverse of the truth.

EXPLANATION OF FIGURES.

The figures are tracings from photographs, with slight modifications. The proportions and leading features are therefore accurate. There are some points of difference between the two brains, and some conditions which may be artificial; these will be referred to in connection with the several figures. Attention is called to the fact that, to one familiar with the brains of Amphibia, Reptiles, and the lower Mammals, the cephalic portion (prosencephal) of the *Ceratodus* brain looks more natural when held upside-down; this is due to the unusual relative positions of the olfactory tract and the cerebral hemisphere.

The following apply to the three figures: The dotted areas represent cut or artificial surfaces; the heavy line, forming the ental margin of the cut surfaces, represents the ***endyma***, which lines the cavities and is reflected over the plexes. The line (usually lighter) which forms the ectal margin of the cut surfaces, and the outline of parts not cut, represents the ***pia***, from which vessels are given off to form the plexes. At some places—*e.g.*, the ***metaplex***, or membranous roof of the ***metacœle***, and the dorso-caudal wall of the saccular ***conarium***—the parietes consist only, or practically only, of the pia and the endyma; at other places—*e.g.*, the greater part of the ***infundibulum***—the nervous constituent of the parietes is very thin. Along the roof of the ***mesocœle*** and the floor of the same region and the parts caudad of it the double outline indicates the existence of a peculiar, thick, almost cartilaginous, and apparently non-vascular envelope, the nature and relations of which are undetermined. No attempt has been made to show the *arachnoid.* From what has been said it will be understood that the clear areas enclosed by the endyma represent the *encephalocœle,* or cavity of the brain, with its extensions into the *conarium* and *hypophysis,* while the clear areas not so included represent natural, pial surfaces. The *metacœle* and *epicœle* together correspond to what is commonly called "fourth ventricle;" the *mesocœle* to the iter, or cavity of the region of the optic lobes; the *diacœle* to the larger part of the "third ventricle;" the *aula,* which is commonly confounded with the third ventricle, is really the mesal division of the *prosocœle,* or irregular cavity of the prosencephal; its other divisions are the *procœle* ("lateral ventricle") and *rhinocœle* ("olfactory ventricle") on each side.

FIG. 1.

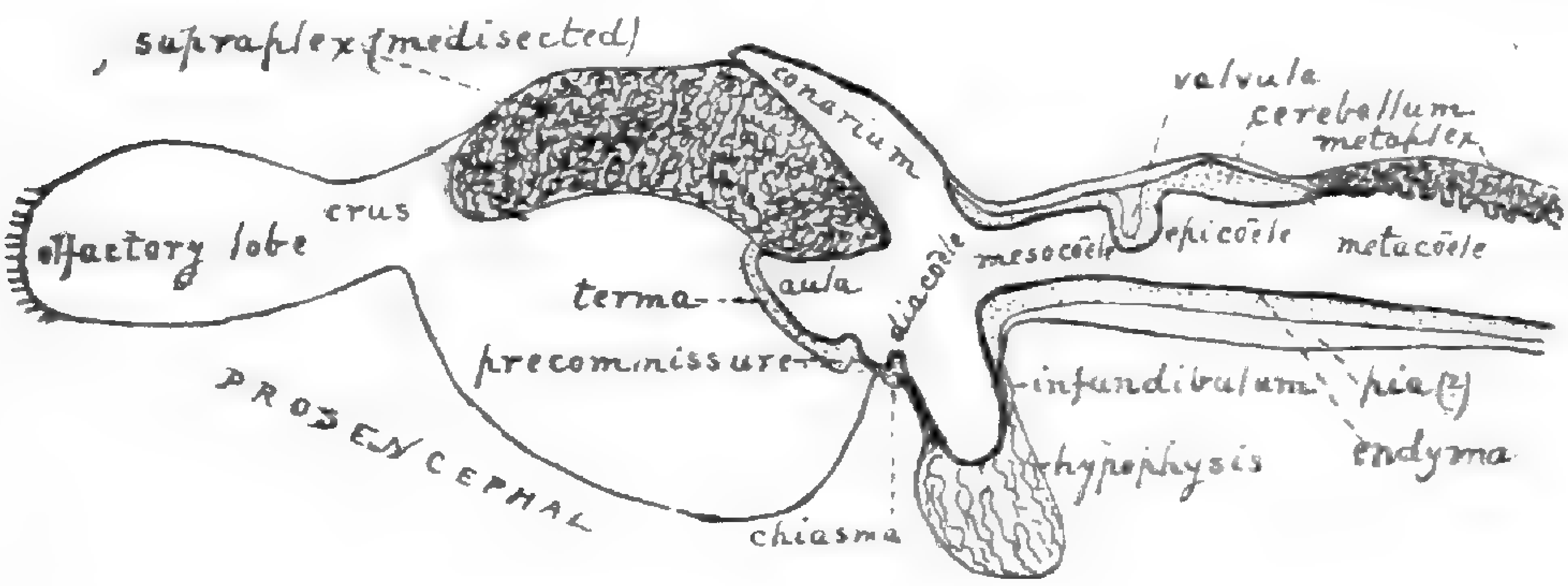


FIG. 1.—Medisection of the brain of No. 425 (× 2). The natural (pial) surfaces are those of the mesal aspect of the olfactory lobe and crus and of the larger part of the "cerebral hemisphere." The supraplex in this specimen is very thick, completely hiding the *prerima,* through which it finds entrance into the procœles, as seen in Fig. 2.

FIG. 2.

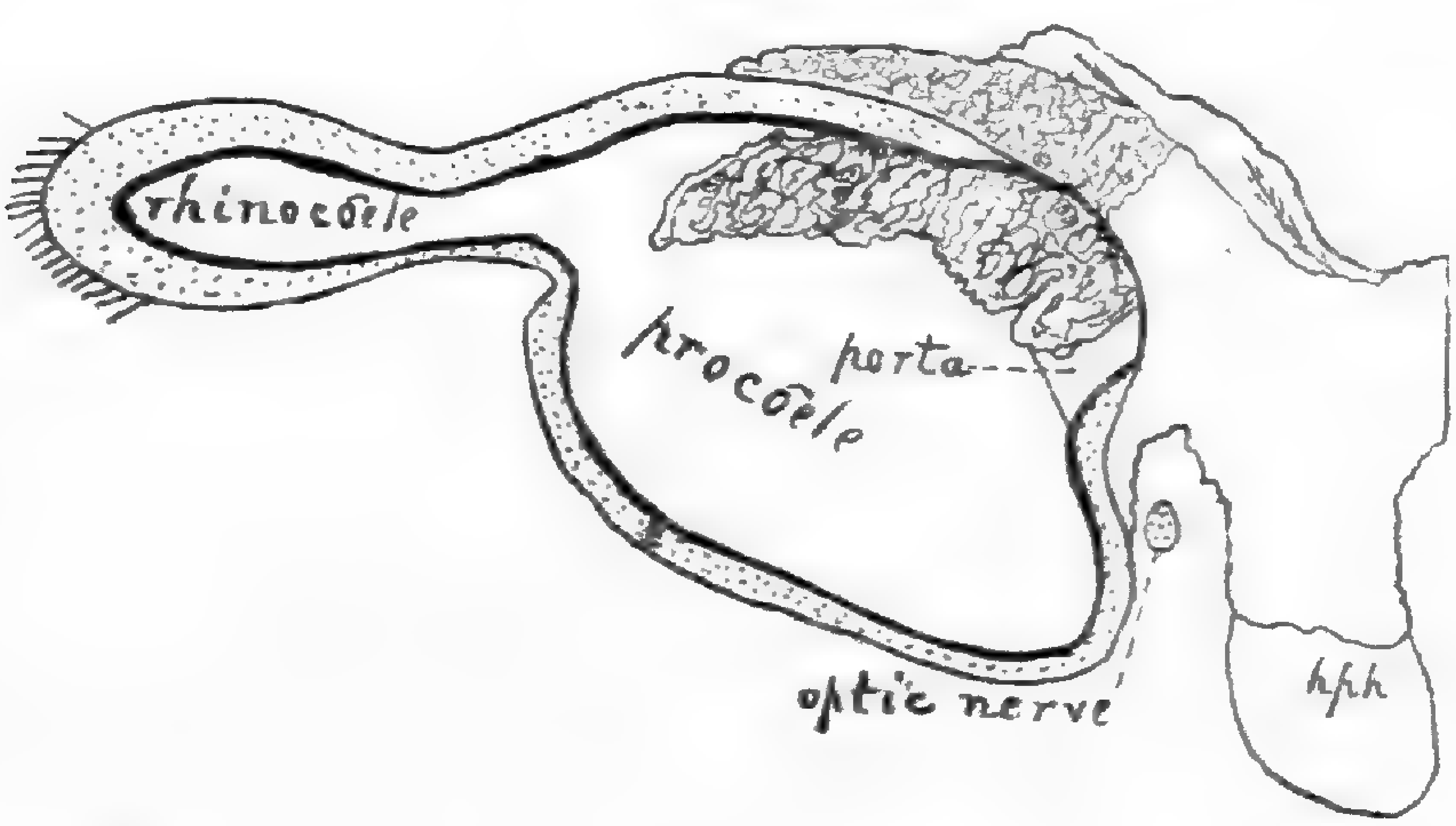
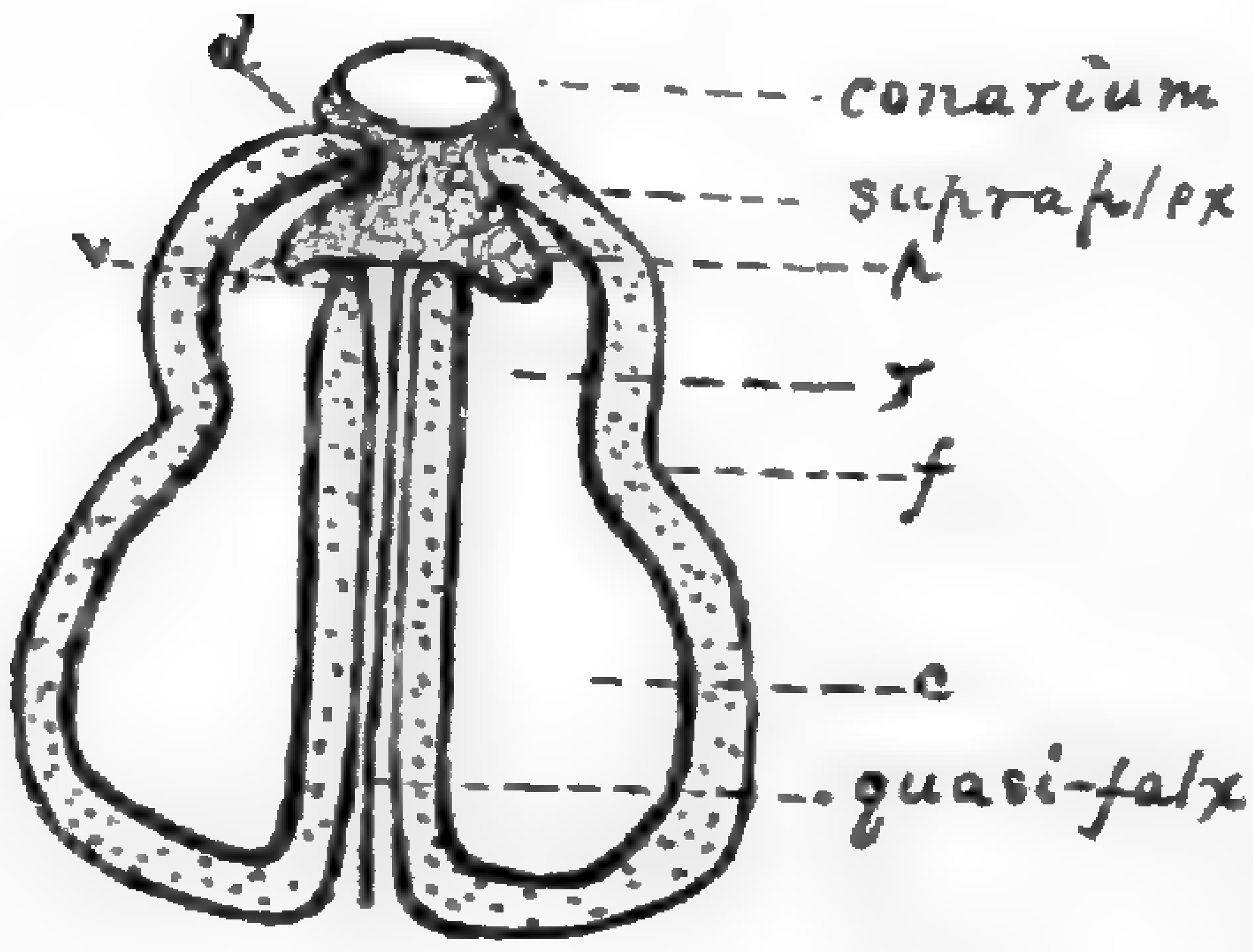


FIG. 2.—Part of the same brain (× 2), the left prosocœle exposed so as to show the extent of the plexus after its entrance. The area marked *porta* is the lateral orifice of the aula, and is more commonly called "foramen of Monro;" *hph* indicates the hypophysis.

FIG. 3.—Transection of No. 424, just cephalad of the conarium (× 3). In this the plexus is not so thick in the dorso-ventral direction, but its prolongations (covered, like all plexes, by endyma) are bulky, and cause the dorsal and ventral margins of the rima (*d*, *v*) to be far apart. Between the mesal surfaces of the lobes is a line representing the membranous but tough *falx*, the exact relations of which to the plexus are not determined; *c* points to the ventral or true cerebral portion of the procœle; *r* to its dorsal part, which is more directly continuous with the cavity of the olfactory lobe. The lateral furrow (*f*) may be significant, but may also be the result of alcoholic shrinkage. It does not appear in No. 425.

FIG. 3.



TERIAS LISA.

(At Ship Island, Gulf of Mexico.)

FRAIL habitant of yonder shore,
  From off the leaf that sheltered thee
What wondrous craft thy being bore
  Safe through the cyclone of the sea!
Thy citron-yellow wings are bright,
  And soft the rosy fringe they wear,
And rays of gloom and silver bright
  Adorn thee, blossom of the air!

The Cassia, on whose silken flower
  Thy fragile life its being fills,
What hast thou garnered of its dower
  To waft thee where thy spirit wills?
What dream of flowers of fairer hues,
  Of lights more beautiful than dawn,
Of winds of balm and honey-dews
  Allured thee ever on and on?

Thou didst but ask, O faëry sprite,
  A blossom cup, the morning beam,
Companions for thy circling flight,
  And love to share thy rainbow dream!

Here on the white, sea-drifted shore
  Thy feeble, fluttering life I scan;
Thou tellest the lesson o'er and o'er,—
  Thou art the history of man.

Laura F. Hinsdale.

BILOXI, MISSISSIPPI.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

WHY does not some master-mind arise and give us a complete work upon unnatural history? Such a treatise is a great desideratum, for its publication would be a great boon to the scientific world. Were there such a work in existence no doubt Congress could be induced to make a liberal appropriation and furnish copies gratis to all who should apply for them. The saving this would afford to publishers and the relief it would vouchsafe to readers and editors would be inestimable, for then that innumerable throng longing to get their names and their lucubrations in print would have no excuse for existence; all their "discoveries" would be forestalled. No more would audiences be bored with fanciful theories of the way in which the ancient Egyptians carved all the Pyramids out of solid rock; nor would editors be compelled to wade through manuscripts proving "incontestably" that albinos were always the result of fright in the pregnant mother, because albinos are most abundant in rabbits, and every one knows that rabbits are the most timid animals in the whole world.—*Q. E. D.*

As was intimated in the opening sentences, a complete unnatural history requires a master-mind and abilities of no common order. There are, it is true, many works which fall but little short of perfection in this line; but, still, a careful search reveals lapses which ruin them as complete encyclopædias of misinformation. Usually the failure arises from the fact that the author is utterly unconscious of the nature of the treatise he is producing. He works in sober earnest, thinking to surprise the whole world; and he would do so were it not that in an evil hour he allows a few really credible facts to creep in. The qualifications necessary are an instinctive ability, not to be acquired by any education, to discriminate between the false and the true, always appropriating the former and rejecting the latter, a love of the marvellous, and a power to quickly assimilate the erroneous. The work must, of necessity, be largely a compilation, for an intellect capable of producing the work would be lacking in the imaginative side, and could not possibly evolve it in its entirety from its inner consciousness. It must be able to trace results from no adequate cause. The syllogism must be ignored. There must be a realization of the magnitude of small things, and a capacity to tear a given statement from its surroundings and set it forth in all its nakedness, without regard to the incongruity of its new position. To all these points must be added a proper modicum of self-esteem, a conviction that all the so-called leaders of science are totally wrong, and that the author alone is infallible.

Such a man as we have drawn would produce a perfect work; but where shall he be found? Several times we have thought ourselves on the right track. We have turned over page after page fully persuaded that the desired work was before us, or, at least, that the author was capable of producing it; but, alas! it is like the American epic, it has yet to be written. The man who described six new genera and thirteen new species of thunder and lightning gave promise, but, unfortunately, he is dead. Who of the living will rise and fill the gap time can only decide. The prize offered for the successful work is a large one,—Immortality, along with Pedro Carolino, the author of "English as she is Spoke." The candidates are many, but, so far, all have shown lucid intervals, or have evinced a disinclination for the task, and have turned to less laborious fields just as they had aroused a hope that here was at last the long-looked-for wonder. When he comes he will receive an ovation from the world of science, which is tired of being told that clams travel on the bottom of water-areas by means of suction through their open shells; that the hippopotamus was designed to dredge out the channels of tropical rivers; that the strongylus is a parasitical action of the intestines; that the bill of the woodpecker has a force of bill proportionately to a twenty-ton trip-hammer; that the Mound-builders used the British inch in laying out their earth-works; that the Anglo-Saxons are the ten lost tribes of Israel; that the alligators originated in a cold climate because they hibernate in a warm one; that the flesh of the sponge is washed off merely by being drawn from the water; that the nettle-cells of the hydroids are shot out with inconceivable velocity to lasso the prey; that—but we forbear. We only hope and pray for a relief, or even a respite, from the continual shower of unnatural history which is being poured out upon a long-suffering world of science.

On a former occasion we referred to the gross injustice which has been perpetrated by the State of Michigan in the matter of its late geologist, Professor Rominger. This gentleman, by economical methods, saved enough of his small appropriation to pay for the publication of his report. When the report was completed the State refused to publish it and retained the surplus in the treasury, where Professor Rominger had, with too great faith, allowed it to remain. The State should either publish the report or return the money to Professor Rominger. Michigan cannot afford a transaction like this to stain her history, and, in view of her general intelligence and liberality to learning, it is surprising that the injustice has not been corrected long ago.

We understand that the fine exhibition of basaltic columns at Llewellyn Park, Orange, N. J., is undergoing destruction. It is being used as a quarry for paving and macadamizing material. This is to be greatly regretted, and we hope that the persons controlling the park will endeavor to put an end to the desecration. It is one of the principal attractions to visitors and residents in the neighborhood, and the authorities of the park will do well to see that it is preserved.

RECENT LITERATURE.

Trouessart's Microbes, Ferments, and Moulds.[1]—This work is intended for the general reader, and not for the specialist in science. In the words of the author, " There is much to be done before modern society is practically on a level with the achievements of science; many prejudices must be uprooted, and many false notions must be replaced by those which are sounder and

[1] The International Scientific Series. Microbes, Ferments, and Moulds. By E. L. Trouessart. With one hundred and seven illustrations. New York, D. Appleton & Company, 1886. 12mo, pp. xii. 314.

more just." This is the laudable task the author sets before himself.

The general plan of the book may be understood from an enumeration of the headings of the several chapters, as follows: Parasitic Fungi and Moulds; Ferments and Artificial Fermentations; Microbes or Bacteria; Microbes of the Diseases of Domestic Animals; Microbes of Human Diseases; Protection against Microbes; Laboratory Research, and Culture of Microbes; Polymorphism of Microbes; The Microbian Theory compared with other Theories set forth to explain the Origin of Contagious Diseases.

In turning over these chapters, so admirably planned to accomplish the author's purpose, one is pained to note the evident want of acquaintance of the author with his subject. A book of this kind should have been intrusted to a specialist, who could have done something to popularize the difficult subject, and not to one who has no specialty, unless it be that of dabbling in everything, "palæontology, bibliography, zoology, general biology, geographical distribution, vertebrates, mammals, ornithology." [1] The result is a book which is so full of errors of interpretation as to greatly lessen its value.

It is difficult to criticise a book like this in detail, and it is perhaps needless, as no ordinary revision could eliminate its faults. Nothing less than a rewriting of most of the chapters would make the book what it should be. A few examples, however, will serve to show the kind of work done by the author. On page 11, we are told that in the mushroom "the part which we eat and call the umbrella represents the flower or floral peduncle of other plants." Fig. 18, which is intended to illustrate *Peronospora infestans*, is not that species at all, but evidently the one on the grape. Fig. 23 is printed upside down. On page 128 occurs a most marvellous jumble; an attempt is there made to discuss the cause of the red color which occasionally appear on ponds, and which is common on the snow in northern regions, and, astonishing as it may seem, Protococcus is regarded as a microbe!

It would be unfair to leave the impression that this book has no value whatever. It may prove to be to some mind the suggestion from which will eventually spring the desire to know more about the "infinitely little" things. Should it do so we should not condemn it too severely, although we might still wish that it had been more carefully prepared.—*Charles E. Bessey.*

Economic Fungology.[2]—Little attention has been given in

[1] See International Scientists' Directory, 1883.

[2] An Elementary Text-book of British Fungi. Illustrated by William Delisle Hay, F.R.G.S., author of "Brighter Britain," etc., etc. London, Swan, Sonneschein, Lowry & Co., Paternoster Square, 1887.

this country, and little more in England, even, to the study of the fungi from an economic, or more properly a culinary, stand-point. Dr. M. A. Curtis, of North Carolina, was reputed to be an expert in distinguishing the edible from the inedible species, but scarcely anything now remains to us of his work, for he published little upon this branch of botany. In England, Badham's "Esculent Funguses," published many years ago, has served in a way to give to the beginner in Economic Fungology little more than a start. Its good plates have always made it valuable.

A late work, with the too ambitious title of "An Elementary Text-Book of British Fungi," by W. D. Hay, is intended to supply the need of a book for the beginner or amateur who wishes to be able to pick out the edible fungi from the host of inedible ones. While the book is by no means such a one as its title would indicate, it *is* fairly successful as an attempt "to collect information relating to such fungi as have an economic value, either as esculents or poisons." The author is not a botanist, and has the honesty to admit that "It has never been my privilege, as yet, to meet with any person versed in mycology from whom I could derive instruction." His practical acquaintance with the larger fungi may be inferred from this sentence from the preface: "But, so far as 'toad-stool eating' goes, I believe I have a right to speak with authority, since my own gastronomic experiments have been many, frequent, and varied."

Of the classification used in the arrangement the less said the better. It is simply atrocious. But let not the botanist toss aside the book as useless on that account. He will find much valuable information in it which he cannot obtain elsewhere. The descriptions are good, and given as they are in popular terms, the tyro will find the task of recognizing the species much simplified. Little can be said in commendation of the choice of English names for the species, and occasionally the English name is as difficult to remember as the scientific one,—*e.g.*, Fork-gilled Green-cap (*Russala furcata*); Infamous Clitocybe (*Agaricus inversus*); Orange Jelly-sprout (*Tremella mesenterica*); Oyster of the Woods (*Agaricus ostreatus*), etc. On the other hand there are some good selections of English names; among these are the following, viz.: Bolet (species of Boletus), Polypore (species of Polyporus), Lactar (species of Lactarius), Ink-cap (species of Coprinus).

A valuable feature of the book is found in the appendix, which is devoted to the preparation of fungi for the table. Here the ambitious cook may obtain many suggestions as to the preparation of appetizing dishes from many a common fungus, with the French name thrown in. Thus we have recipes for Pratelles à la Bourgeoise, Pratelles à la Provençale, Bolets à la Citoyenne, Oaktongue à l'Américaine, Puffball à la Lyonnaise, Puffball à la Grande Duchesse, etc.

The plates, of which there are sixty-nine, consist of the woodcuts of Cooke's "Handbook" arranged upon the pages. Not more than a dozen or so of these plates have any connection with the text, and they are consequently of no sort of value. Evidently the publisher had these on hand, and put them in to fill up. They add thickness to the book, and doubtless add also to its cost.—*Charles E. Bessey.*

Colton's Elementary Course of Practical Zoology.[1]—This work is truly an elementary one,—not a text-book, but a series of guides to the study of certain typical animals, with the aim of giving the student, by following the directions given, such a practical acquaintance with comparative anatomy as will enable him to obtain a clear idea of the animal kingdom. Classification of the objects chosen is not attempted, for the much alike grasshopper and cricket commence the work, and are followed by examples of the other hexapod orders. Then come studies of the spider, millipede, and various Crustacea, to which succeed the earth-worm, clam, and snail. The Infusoria and Amœba come after these, and then the author proceeds to the fish, the frog, the snake, the turtle, and the mammal, which are succeeded by the echinoderms, cœlenterates, and sponges. This arrangement seems to have been carefully considered in the adaptation of the work to the needs of those who will most use it,—students in academies and high schools,—and here this has a marked advantage over those laboratory manuals which follow a cut-and-dried system. By first examining closely-allied forms they are led to comparative work, while the order of the subjects is such as to accommodate the increasing skill of the pupil in manipulation. The work is really a valuable one for beginners in zoology, and deserves the success with which we understand it is meeting.

Lydekker's Catalogue of Fossil Mammalia.[2]—Mr. Richard Lydekker, formerly of India, has recently followed up his extensive series of papers upon the fossil fauna of Hindustan by a valuable catalogue of the Fossil Mammalia of the British Museum of Natural History. The portion of the catalogue issued comprises four volumes of the usual size of the British Museum series, with rather more than one thousand pages and one hundred and thirty-four illustrations. Part I. contains the Primates, Chiroptera, Insectivora, Carnivora, and Rodentia. Part II. the Ungulata Artiodactyla. Part III. the Ungulata Perissodactyla, Toxodontia, Condylarthra, and Amblypoda, while Part IV. is entirely occupied by the Proboscidea. The classification is based

[1] An Elementary Course in Practical Zoology. By Buel P. Colton. Boston, D. C. Heath & Co., 1886.

[2] Catalogue of the Fossil Mammalia in the British Museum (Natural History). Part I. By Richard Lydekker, B.A.F.G.S., etc. London, 8vo. 1885. Printed by order of the Trustees Brit. Mus.

upon that adopted by Professor Flower, but is modified to make it include the host of extinct forms here dealt with. In his preface the author avows himself one of that school of naturalists who use generic terms in a wider sense. The Pikermi and Mont Leberon beds are classed as Pliocene, the Eppelsheim beds as uppermost Miocene; the Ronzon and Hempstead (Isle of Wight) beds as lowest Miocene (the latter with a query); the Quercy phosphorites form the top of the Eocene, while the Egerkingen beds of Switzerland are placed at the bottom of the Upper Eocene. Among the peculiarities of classification is the inclusion of the dogs as a subfamily (Caninæ) of the Ursidæ. The Proboscidea include three species of Dinotherium, twenty-six of Mastodon, and eighteen of Elephas.

Report of the U. S. Commissioner of Fish and Fisheries, 1883.—This report contains twelve hundred pages of valuable matter and numerous illustrations, among which may be especially mentioned the eleven plates of Cetaceans, which illustrate Mr. True's suggestions to lighthouse-keepers and others relative to collecting examples of these animals. The report proper occupies only ninety-five pages, including a statement of the results of the inquiry into the history and statistics of food-fishes and an account of the progress of pisciculture. In the appendices we find papers by Stone, Tanner, Smiley, Duff, Day, Ljungman, Lundberg, Verrill, Bush, Eisen, Shufeldt, Seal, Mather, Benecke, etc. The most voluminous appendix is that relating to natural history and biological research. Nearly two hundred pages of this are occupied by Professor Verrill's account of the results of the explorations made by the "Albatross" in 1883. Lieutenant Tanner devotes a still larger space in Appendix A to the construction and outfit of the "Albatross," and a report upon the work done during the cruise of 1883. The "Albatross" reports are profusely illustrated.

Gustav Eisen's "Oligochætological Researches" and Dr. Shufeldt's "Osteology of *Amia calva*" are valuable special papers.

Biographical Memoirs of the National Academy of Science, Vol. II.—This volume contains fifteen biographies of deceased members of the National Academy, including the well-known names of Louis Agassiz, Jeffries Wyman, J. P. Kirtland, J. L. Le Conte, A. Guyot, and J. W. Draper.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

Miscellaneous.—Major-General Tillo has calculated, from the most reliable data, the lengths of various rivers, and gives the following as the eight longest: (1) Missouri-Mississippi, 4194 miles; (2) Nile, 4020; (3) Yang-tsze-kiang, 3158; (4) Amazon, 3063; (5) Yenisei-Selenga, 2950; (6) Amur, 2920; (7) Congo, 2883; (8) Mackenzie, 2868. The map of Humphreys & Abbot is the authority for the Missouri-Mississippi, which Klöders gives as 3658 miles.

American Notes.—Governor Fontana, of Chubut, has recently explored the Chubut and its tributary, the Charmate, passing through the Andes by a very low pass, since the confluence of the two mentioned rivers is only eighteen hundred feet above sea-level, and at sixteen hundred feet above the sea the valley of the Cercorado, a river flowing into the Pacific, was reached. On their return the party found a large lake, through which the river Senguel flows. The Welsh colony on the Lower Chubut will probably colonize on this lake.

Don Jose Santelices has ascended Licancaur, a volcano on the eastern boundary-line of the Chilian province of Antofogasta. Tambos—houses of a single room, with a low, stone bench—are found on the Inca road which leads to the summit. The crater was found to have a bottom thirteen hundred feet in diameter, with a pond four hundred feet by three hundred and fifty feet in its centre. On its banks there are remains of some thirty large stone houses built by the Indians, and a large quantity of fuel

[1] Edited by W. N. Lockington, Philadelphia.

was found there,—whether carried there by the Peruvians or by the Calchaquis, who opposed them, is not certain.

African Notes.—The Wagenia, or Wenga, who live near Stanley Falls, are stated by O. Baumann, of Dr. Jenz's Expedition, to be on friendly terms with Tippoo Tib, and thus far to have not been demoralized by the influence of the Arabs.

Stanley reached Bansa-Manteka, below Stanley Pool, before March 29. He intends to ascend the Mburu, which is now known to be navigable for some distance. From the head of navigation he will strike across country to the Albert Nyanza at Murswur, where he will form a fortified camp, and whence he will send boats to inform Emin Bey of his arrival. It appears that the intercourse on both banks of the Kongo above Stanley Pool is interrupted by the attacks of the natives upon the caravans.

Tippoo Tib has discovered a tribe of people whose money consists of copper spears. These people make highly-artistic metal-work, and manufacture enormous spear-heads of very thin copper, which are passed from hand to hand like bank-notes. In the purchase of ivory one is worth two hundred pounds. Everything among them has its value reckoned in terms of spears.

Lieutenant Baert has recently ascended the Mongalla, a northern tributary of the Congo considerably to the east of the Mobangi, as far as the limit of navigation, and to a distance of two hundred miles from its mouth. The river flows in a general southward direction through a well-wooded country, and the rapids, which stayed farther ascent, occur in about 3° 30′ N. latitude and 22° E. longitude. As this is north of the latitude reached upon the Welle by Dr. Junker, it looks as though the latter river must certainly be cut off from joining the Mobangi.

It is evidently premature to suppose that the Welle is identical with the Mobangi, although Dr. Junker followed its course to 22° 47′ 40″ E. and 3° 13′ 10″ N. latitude. Its level is not accurately known, and it may turn into the Congo by some other course, or even find its way to Lake Tchad.

Four months later than the advices brought by Dr. Junker, Emin Pasha, accompanied by Dr. Vita Hassan, ten Egyptian officers, three Greeks, and four negroes, visited the capital of Unyoro, and sent a message to Mwanga, king of Uganda, requesting an audience. This was granted to Emin, Hassan, and the three Greeks only, but permission to pass through Uganda to Zanzibar was refused.

It is quite evident that the Arabs are masters of the Upper Congo, and Tippoo Tib's appointment as Governor of Stanley Falls Station is virtually a surrender of that part of the river into their hands.

Lieutenant Wissmann has been exploring in the land of the

Baluba and the basin of the Lubilash. He and De Macar, the commander at Luluaburg, visited the residence of Mona Tenda, near the Lukula. The people are Bashilange, and the country is densely populated. The eastern bank of the Lukula belongs to the Baluba, and forms an undulating prairie, which, though barren in appearance, has a numerous population. Wissmann intends to go north and explore the region where the Lulongo, Juapa, and Lomami have their sources.

The Rev. G. Grenfell, in a recent ascent of the Kwango in the "Peace," found a large tributary, the Juma, entering the river from the east, and bearing so great a quantity of water that it was doubtful which was the larger stream. He ascended the great bend of the Kwango, which at 4° 30′ south comes back to its northerly course. The Kikunji Falls, which stopped his ascent, are only about three feet high. Mr. Grenfell has since returned to England.

M. Grandidier and Mr. Sibree, in the *Antananarivo Magazine* (Christmas, 1886), point out that about thirty miles of canal would convert the channels and lagoons of the east side of Madagascar into an extensive internal water-way of great commercial value.

The "Bolletino" of the Italian Geographical Society publishes a detailed account of the Italian possessions on the Red Sea. Assab and the surrounding district is absolutely annexed, while Massowa, Emberemi, the Abd-el-Kader Peninsula, Gherar, the Taulud Island, and the Dahlak Archipelago are garrisoned and administered by Italy, and the coast from Annesley Bay to Assab is under Italian protection.

Dr. Colin contributes to the *Revue d'Anthropologie* a paper on the Malinkes of Bambouk, once a ruling race upon the Upper Niger, but now divided into numerous little states, and apparently without a religion, though they were once Mohammedan. Their territory is about six hundred kilometres long and from eighty to one hundred and fifty in width.

Don Manuel Iractier has paid two visits to the newly-acquired Spanish territory on the east coast of Africa. On his last journey (1884–85) he traversed four thousand miles between the equator and 3° N. latitude, penetrating from the seaboard to about 20° E. longitude, and surveying to their sources all the streams between the Rio del Campo and the Gaboon. Of these by far the largest is the Muni, which debouches in Corisco Bay, after receiving the waters of the Utamboni, Noya, and other affluents, and draining nearly six thousand square miles.

Major Serpa Pinto and Lieutenant Cardoso have arrived in Lisbon, after exploring the region between Mozambique and Lake Nyassa. The Lienda, a tributary of the Rovuma, was found not to rise in Lake Nmaramba, but to flow through that basin from Mount Songe, farther to the west.

Asiatic Notes.—Messrs. James, Younghusband, and Fulford have recently travelled from Mukden, the capital of South Mantchuria, up one of the tributaries of the Yalu, and through the main chain of mountains by a pass two thousand seven hundred feet high to the Chang Peishan, or ever-white mountain. This is a recently extinct volcano, with a clear lake in its crater. The loftiest of the peaks around this crater is seven thousand five hundred and twenty-five feet above the sea. The sides are composed of disintegrated pumice. This mountain is the centre of the river-system of Manchuria, since the rivers Yalu, Tumen, and Sungari all have their sources there. Descending the Sungari, the party went to Kirin, and thence to Tsitsihar, the capital of Northern Manchuria. Southeast of Tsitsihar they crossed a high and undulating steppe, with numerous brackish lakes, from the earth of the shores of which soda and salt are obtained.

M. Potanin left the Koko-Nor June 25, 1886, crossed the Gobi from south to north, and discovered four parallel mountain-ranges continuing the Altai chain to the southeast. That part of the Nan-Shan Mountains which separates the plains of Southern Mongolia from the region drained by the Hoang-ho is composed of three mountain-ranges, with passes twelve thousand eight hundred feet high and valleys ten thousand feet above the sea. On his way north he fell in with the before-unknown tribe of Jegurs. He surveyed the country passed over.

Sr. E. Modigliani has visited Nias, an island some thirty miles from the west coast of Sumatra. The natives are fierce savages, everywhere addicted to head-hunting, and the rajah of Bavolovalani had no idea of collecting skulls except from the living subject. Owing to local feuds the explorer did not go far into the interior; yet on a second visit contrived to bring away a large quantity of valuable material. The natives of Nias are evidently Malays; yet their crania look as though a Papuan skull were fastened to a Malay face. Their weapons are of iron, and they work iron, brass, and gold for themselves. They have axes, barbed lance-heads, and swords like the parangs of the Dyaks. Their shields are heavy and coated with buffalo-hide, and they make curious iron helmets. Their swords are sheathed in wood, and have a globular wicker or rotang basket in front. Every young man must have cut off one head,—no matter if of man, woman, or child.

MM. Bonvalot and Capus, the French travellers who have recently been turned back by the Emir of Afghanistan, write to the French Geographical Society that the country between Teheran and Meshed belongs to the steppe region of Central Asia by its fauna, flora, and geology. The journey between these places was, for most of the way, on the edge of an immense basin, the bottom of which is the Khevir, or great salt desert.

From the bridge of Saugil to the Thian Shan, from west to east, such a thing as a forest is not known.

Manipur is a valley surrounded by mountain-ranges which have a rain-fall as high as or higher than one hundred and twenty inches. The valley has but thirty-nine inches of rain-fall. The snow-line is low here. The whole valley, three thousand feet high, was covered with hoar-frost in December, and Sarameti, under thirteen thousand feet high, has, the natives say, snow all the year. Dr. G. Watt correlates the lowness of the snow-line with the immensity of the rain-fall, which in winter is a snow-fall. This great rain-fall accounts for the volume of water brought down by the Irawadi, while a river travelling for hundreds of miles in Thibet would pick up but a small quantity.

General J. T. Walker recently read before the Geographical Society of London a paper upon the Lu River of Thibet, the Lu Kiang or Lu-tse-Kiang of the Chinese. This river is generally held to be the source of the Salween, but General Walker adduces reasons for believing it to be that of the Irawadi.

Freiherr von Schleinitz has recently accomplished a survey of Huon Gulf, in German New Guinea, establishing the direction of the coast-line, and the position of the reefs and of eight hitherto unknown harbors. He has discovered nine new rivers. One of these, the Markham, has a broad valley extending far inwards between high mountain-ranges. The south coast of Huon Gulf consists of primitive and metamorphic rocks, with sedimentary rocks and volcanic formations. A further survey afterwards made of the coast, from Astrolabe Bay to the mouth of the Empress Augusta River, led to the discovery of a series of bays, harbors, islands, and rivers.

European Notes.—*Spain.*—It is high time that some common errors regarding the condition of Spain were corrected. It is commonly believed that the country is unprogressive and the people semi-mediæval. This is far from being the case. Spain is advancing with a rapidity quite equal to that of other western European nations, but, as she started later, she is still behind. Her population, unlike that of France, is continuously on the increase, and, as there is still plenty of room in the country, it is likely to keep on increasing until, in a few decades, Spain will again claim her right to stand among the foremost nations of Europe. Most of the great central plain of Castille and Leon is capable of the closest cultivation, and probably received it in the days of Moorish occupation, for it is crossed by numerous mountain-ranges, which give rise to many rivers. The coast provinces and the Ebro Valley are capable of supporting an immense population, and do so in spots that are favored by the application of the necessary industry. There are at the present time twenty-two millions of people in Spain, whereas at the end of the reign of Charles III. it is probable that the population barely reached eight millions. Some figures given by Sr. Costanzo Stella in the London *Times* show clearly the progress of the country. The agricultural population, which was but three million six hundred and fifteen thousand eighty-five years ago, is now nine million three hundred and twenty-eight thousand, and the area cultivated has increased from fifty-three million acres to one hundred and ninety-three million five hundred thousand. The head of cattle have doubled since the commencement of the century, and the industrial population has trebled. In 1860 exports and imports together were only twenty-five million eight hundred thousand pounds, whereas they are now fifty-six millions. The wine of Spain, which two decades ago could not be brought into the world's market, except from spots situated within easy distance by bullock-wagon of some port, can now be borne upon six thousand miles of railway, and the produce is reckoned at four hundred and sixty-one million two hundred and fifty-six gallons.

Prof. Miguel Marazta has discovered, in the valley of Rebas (Gerona, Spain), at the end of the Eastern Pyrenees, a race of dwarfs not more than four feet high. All have red hair, broad faces, strongly-developed jaws, flat noses, and rather oblique eyes. A few hairs take the place of a beard in the males, and the sexes are very much alike. The lips do not quite cover the large, projecting incisors. They live by themselves, intermarry, and have no chance of improvement. Are they the remnants of some old Mongoloid stock?

The last French census (May, 1886) shows an increase of only one per cent. per annum, and the last German census one of .71 per cent. per annum. In both cases this is a decrease in the rate, Germany, as well as France, having commenced to proportion its increase to the means of subsistence.

GEOLOGY AND PALÆONTOLOGY.

The Sea-Saurians of the Fox Hills Cretaceous.—The reptiles of the sea of the Fox Hills epoch possess considerable interest as being the last of their race; for the next epoch (the Laramie) saw, as is well known, the beginning of the lacustrine conditions which prevailed throughout the interior of North America, in one region or another, during the subsequent ages of Cænozoic time. The vertebrate fauna was more or less changed, especially so as regards the inhabitants of the waters. The most important modification of this kind with which we are acquainted is the extinction of the order Sauropterygia from the interior waters of North America. I have made some attempt to collect remains of these animals, but without any great success, for two reasons. One of these is the rarity of the specimens; the other is the disarticulated condition in which they are usually found.

Preliminary to a fuller account of the species, I give the following abstract of the results I have been able to obtain.

The Plesiosauridæ have been well divided by Seeley[1] by reference to the characters of the scapular arch and sternal region. Another criterion of difference is to be found in the form of the propodial bones. In the Polycotylinæ they are wider than long, and angular in form, resembling those of Ichthyosaurus. In the Plesiosaurinæ they are well-differentiated elements, as in Mosasaurus, or marine turtles. There are two genera of Polycotylinæ, both American, as follows:

Neurapophyses and all diapophyses and parapophyses coössified with vertebral centra	*Polycotylus.*
Neurapophyses and other processes articulating freely with centra	*Piptomerus.*

Of these, Piptomerus is represented by numerous remains in the Fox Hills beds of New Mexico. Other species occur, which present the following characters:

Neural arches loosely articulated	*Plesiosaurus.*
Neural arches coössified, parapophyses free	*Orophosaurus.*
Both neural arches and parapophyses coössified	*Uronautes.*

Of these genera, Uronautes has been previously obtained in the Fox Hills bed of Montana.[2] The probable character of the propodial bones refers it to the Plesiosaurinæ. These parts are unknown in the species referred to the two other genera named. Nor is it certainly known whether the structure of the shoulder-girdle is like that of Elasmosaurus or of Plesiosaurus; so that reference of a species to the last-named genus is provisional. The only possible duplication of names of the above genera is in the case of Orophosaurus, which might possibly be referable to Cimoliasaurus (Leidy); but if, as I believe, the individual described is adult, the two genera are quite distinguishable. The other characters of the genera and of the species are as follows:

Piptomerus Cope, g. n.—Cervical vertebræ short, slightly biconcave; dorsal vertebræ very short, nearly amphiplatyan; nutritive canals many, large. In the known species the articular surface is reflected on the sides of the centrum, so as to restrict the width of the dense layer. In the known species there is no nutritive foramen between the facets of the neur- and parapophysis in the cervical vertebræ. Free extremities of parapophyses thin-edged.

Piptomerus megaloporus, sp. nov.—Cervical centra wider than deep, longer than the dorsals, with a rather wide plane between fossæ of neur- and parapophysis. Two inferior foramina. Sutural surfaces of articular fossæ generally not roughened. Dorsal centra much compressed; neurapophysial fossa very oblique,

[1] Quarterly Journal Geological Society London, 1874, p. 436.

[2] Proceedings Academy Philada., 1876, p. 345.

with a large foramen below its external margin. Two or more small foramina on the inferior surface.

Diameters of a cervical vertebra,	anteroposterior	.0175
	vertical	.023
	transverse	.030
Diameters of a dorsal vertebra,	anteroposterior	.0125
	vertical	.029
	transverse	.027
Diameters of a propodial bone,	length	.019
	width	.043
	depth	.020

An abundant species in New Mexico.

Piptomerus microporus, sp. nov.—Dorsal vertebræ larger, and with a comparatively small nutritive foramen adjacent to the neurapophysis. Cervical vertebræ (if correctly identified) less robust than those of *P. megaloporus*, and with the neur- and parapophysial fossæ separated by a narrow plane-surface.

Diameters of cervical centrum,	anteroposterior	.016
	transverse	.035
	vertical	.0215
Diameters of dorsal centrum,	anteroposterior	.019
	transverse	.036

Two dorsal vertebræ certainly, and probably several others, and a cervical vertebra represent this species. New Mexico.

Piptomerus hexagonus, sp. nov.—Founded on a cervical vertebra, which is less robust than those of the other species, and which differs in having the neur- and parapophysial surfaces adjacent, and not separated by a plane-surface. The two inferior foramina are of very large size, and are well separated.

Diameters of cervical centrum,	anteroposterior	.013
	vertical	.024
	transverse	.031

Several similar but smaller vertebræ are contained in the collection. New Mexico.

Orophosaurus pauciporus, sp. nov.—Represented by parts of three cervical vertebræ, with large parapophysial fossæ looking downwards and outwards, which present a coarse sutural surface of the fundus. The basis of the entirely connate neurapophysis is compressed, and between it and the margin of the parapophysial fossa is an obtuse longitudinal angle. A very small nutritive foramen at the base of the neurapophyses. No other lateral foramina.

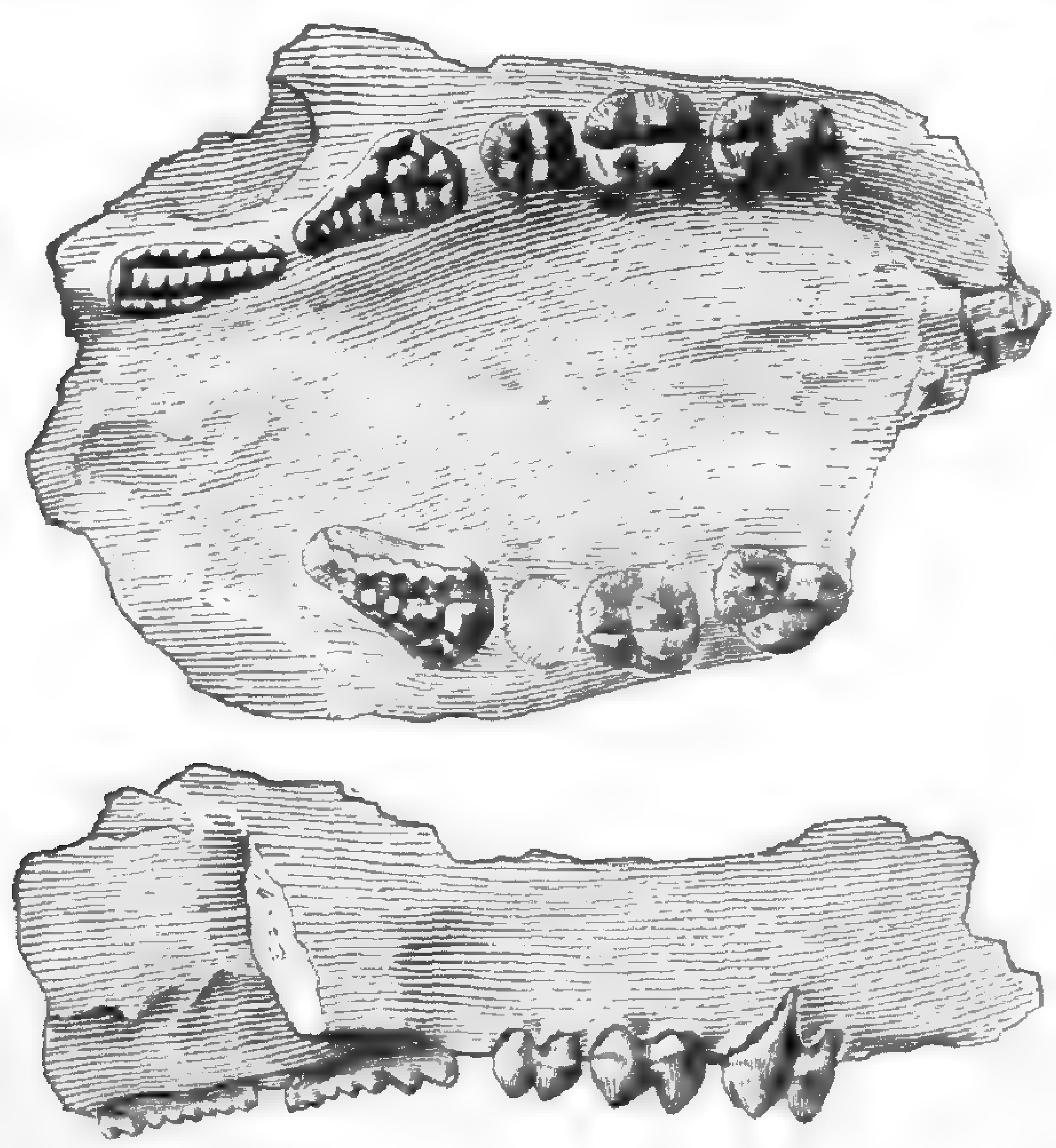
The vertebræ are more robust than those of Piptomerus, and are but little wider than deep. The articular surfaces are slightly concave medially and swollen at the circumference, where they are separated from the lateral surfaces by a shallow groove. Lateral surfaces with irregular, shallow, pore-like fossæ.

Diameters of articular face of cervical vertebra	anteroposterior	.034
	vertical	.040
	transverse	.046
Diameters of parapophysial fossa of same	vertical	.018
	transverse	.024

New Mexico.

In addition to these species, I have vertebræ of three other species of Plesiosauridæ from the Fox Hills bed of New Mexico, which are not sufficiently well preserved for description. One of these is nearly allied to the *Uronautes cetiformis* Cope, but is larger than the type. The other two may be provisionally referred to Plesiosaurus. Accompanying them are *Ischyrhiza antiqua* Leidy, Enchodus, sp., *Galeocerdo pristodontus* Ag., Otodus, sp., and other characteristic forms. The characters observed in the cervical vertebræ of the six species of Sauropterygia of the Fox Hills formation, confirm a hypothesis proposed by the writer in 1879.[1] This is that the necks of the species grew shorter with lapse of geological time, and as the sea shallowed. The long-necked forms are in America confined to older horizons of the cretaceous.—*E. D. Cope.*

The Marsupial Genus Chirox.—This genus was described by the writer in 1883,[2] from a few teeth of the upper jaw found



Chirox plicatus Cope, palate with dentition, viewed from below; $\frac{3}{2}$ natural size.

in the Puerco formation of New Mexico. Since then a palate with the entire molar series of one side and nearly all that of

[1] American Naturalist, 1879, p. 131.
[2] Proceedings Amer. Philos. Soc., p. 321.

the other has been obtained. This shows that the teeth described are premolars, and that there are two true molars, which resemble those of Polymastodon and Neoplagiaulax. The premolars are a good deal like those of Plagiaulax, as described to me by Professor Osborn, and the question arises whether the dentition in question does not belong to Ptilodus. There are two reasons for answering this question in the negative. First, in Plagiaulax and Neoplagiaulax, according to Osborn and Lemoine, there is a tooth in the superior series resembling and opposing the peculiar-cutting fourth premolar of the inferior series; second, the only tooth which could oppose such an inferior premolar is the first molar, and this is not worn obliquely, as in Plagiaulacidæ, but transversely, as in Polymastodon. This and the second true molar support two and parts of a third longitudinal rows of cusps, which are, on the last tooth, worn by anteroposterior movement of an inferior tooth of corresponding form.

Chirox, then, is allied to the Polymastodontidæ, but differs from it in the possession of superior premolars. I therefore see in it the representative of a new family which I call the Chirogidæ. This family forms an interesting connecting type between the Plagiaulacidæ and the Polymastodontidæ. Chirox further differs from Polymastodon in having a second superior premolar of identical form with the first. It constitutes another indication of the Mesozoic character of the Puerco fauna.—*E. D. Cope.*

Geological News.—Silurian and Devonian.—H. A. Nicholson describes, in the *Annals and Magazine of Natural History*, some new and imperfectly-known Stromatoporidæ. Four of the species of Clathrodictyon occur in the Devonian and one in the Silurian of Canada.

M. Bureau has taken casts of some markings upon a muddy surface, and found that he had well-characterized Bilobites. Yet the markings were made by the tail of a shrimp in swimming.

Mesozoic.—Mr. A. S. Woodward notes the undoubted presence of a columella in the skull of Ichthyosaurus, and figures the same (*P. Z. S.*, June, 1886). Professor Cope had first given a diagrammatic outline of the bone.

Mr. J. Carter, in a recent communication to the London Geological Society, adds fifteen or sixteen species to the fossil Decapoda of Great Britain. These occurred in the Oxford Clay at St. Ives. Only one had previously been recorded as British, seven were new to science, and nearly all are Macrura.

Tertiary.—The fossil Mammalia of Maragha, in Northwestern Persia, include many species identical with those of Pikermi, Greece. The deposit was discovered thirty years ago, and the beds, which are situated to the east of Lake Urumia, consist chiefly of reddish marls of fluvio-lacustrine origin. A Hipparion, probably identical with the Pikermi *H. gracile*, is the most abundant. *Giraffa attica*, *Palæoryx pallasi*, *Sus erymanthius*, *Mastodon pentelici*, and *Helladotherium duvernoyi* are among the remains, as is also the French *Felis brevirostris*.

The lower jaw of a Machærodus has been described from the "Forest-Bed" at Kessingland, Suffolk, England. The describer, Mr. J. Backhouse, stated his belief that hitherto no lower jaw of the genus had been found in England.

Mr. Lydekker has given to the Geological Society of London a list of the Cetacea of the Oxford Crag. These include Balæna (4 sp.), Megaptera (3 sp.), Balænoptera (4 sp.), Cetotherium (4 sp.), and *Herpetocetus scaldiensis*, together with nineteen species of Physeteridæ, one Squalodont, and three Delphinidæ. There are seven species of Mesoplodon.

Out of seventy-eight species or varieties of chilostomatous Bryozoa from a deposit in New Zealand, which was considered Miocene by Tenison-Woods, sixty-one are known living, and it would thus seem that too remote an age has been assigned to the deposit.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The second[2] paper devoted to the study of the massive rocks belonging to the "Cortland series" on the Hudson River, near Peekskill, has recently appeared in the *American Journal of Science*.[3] In this paper the author, Dr. G. H. Williams, describes the norites and related rocks, which make up by far the greater part of the entire Cortlandt series. These norites are divided into norites proper, hornblende norites, mica norites, hyperites or augite norites, and pyroxenites. The norite proper is very rare, almost all sections showing the presence in small quantity of minerals which would, in accordance with a strict classification, require the rock to be placed in one of the other four groups. The most interesting facts brought out in the examination of these rocks are (1) the occurrence of orthoclase in several specimens, and (2) the existence of numerous inclusions in this orthoclase and in the more prevalent andesine. The orthoclase is in porphyritic crystals, in which are sometimes imbedded smaller crystals of plagioclase. Under the microscope the former is seen to possess a "shagreen" surface, due to numerous oval indentations. All the feldspar of the norites is filled with little inclusions of plates, rods, and dots. These seem not to be arranged in any definite position with regard to crystallographic

[1] Edited by Dr. W. S. Bayley, Madison, Wisconsin.

[2] *Cf.* American Naturalist, March, 1886, p. 275.

[3] Amer. Jour. Science, xxxiii., February, p. 135; March, p. 191.

planes, as demanded by Judd's shillerization theory, but are grouped in zones. They are regarded by Dr. Williams as original and representing the forms in which the iron first separated from the magma, this separation occurring contemporaneously with the crystallization of the feldspar. Many of the mica norites possess a well-marked schistose structure, a fact which led Professor Dana[1] to ascribe to them a metamorphic origin from sedimentary deposits. A study of their thin sections, however, shows this schistosity to be but another instance of the secondary development of this structure by pressure. The iron ore and emery deposits of this region were also examined. This ore is composed essentially of octahedral crystals of magnetite imbedded in a dark green mineral with the composition and optical characteristics of hercynite (or pleonaste, with a very low percentage of magnesium). This mineral is also found disseminated in small octahedral crystals in the rock adjoining the ore veins. Associated with the magnetite and hercynite of the ore occur also fibrolite and corundum.——The same author, in a communication in *Science*,[2] declares, as the result of microscopical examination, that the serpentine occurring at Syracuse, N. Y., must be regarded merely as an altered peridotite. The remains of bronzite crystals can still be detected in the rock, and consequently the view of Professor Sterry Hunt, that it must be looked upon as an altered sediment because of its intimate association with sedimentary beds of gypsum, can no longer be maintained.——In a preliminary "Note on the Volcanic and Associated Rocks of the Neighborhood of Nuneaton," England, T. H. Waller[3] mentions the occurrence there of ashes (tufa) composed of pieces of feldspar, a little quartz, and grains of some basic rock; a felsite with porphyritic crystals of quartz, in which lines of secondary fluid inclusions are well exhibited; a diabase porphyrite with augite twinned according to both twinning laws,—viz., parallel to $0P$ and $\infty P \bar{\infty}$; and, finally, indurated quartzites with the individual quartz grains enlarged by the addition of new quartz material whose optical orientation is identical with that of the original grains.——In connection with the statement of Dr. Williams in regard to the serpentine of Syracuse, it may be of interest to call attention to an article in which J. H. Collins[4] cites several examples to prove that "some beds of a common series have been changed into serpentine, while others (pass over) into hornblende schist." He thinks that many of the serpentines of Cornwall, which have heretofore been regarded as having originated by the alteration of intrusive sheets of picrite, may as well be considered as having originated in some other manner.

1 Amer. Jour. Science, xx., 1880, p. 218.
2 Science, March, 1887, p. 232.
3 Geological Magazine, July, 1886, p. 322.
4 Ib., August, 1886, p. 359.

Meteorites.—Very recently the name *giovanite* has been proposed by Meunier[1] for a brecciated[2] meteoric stone which fell at San Giovanni d'Asso, near Siène, in Italy, in 1794. Specimens of this same fall have been described previously, but the individual pieces were so small that the interesting facts which Meunier has discovered upon the examination of a larger specimen were overlooked. Meunier finds that this giovanite is made up of fragments of the rock limerickite cemented together by a substance with all the characteristics of leucite,—*i.e.*, the relations of these two substances are inversely what they are in *mesminite*, in which fragments of leucite are imbedded in limerickite. After briefly discussing the subject of the origin of this structure, Meunier concludes that there must be a community of origin for various meteoric rocks, and that in this common place of origin geological action (as we understand it) must exist. He further states that the analogy which it is sought to establish between meteors and comets (and shooting-stars) cannot be maintained.——Two meteors of considerable ethnological interest are described by Mr. G. F. Kunz[3] in the *American Journal of Science* for March. The first is a meteoric stone composed of rounded and angular pieces of olivine in a ground-mass consisting of iron. Analyses of the two constituents yielded Mr. Mackintosh the following figures:

Olivine: $SiO_2 = 37.90$; $MgO = 41.65$; $FeO = 19.66$; $MnO,CoO = 0.42$.
Iron: $Fe = 82.45$; $Ni = 16.40$; $Co = 1.09$; $P = 0.05$.

The author regards this meteor, which was found in Carroll County, Kentucky, as part of the same mass from which the iron was obtained for making the iron ornaments found in the Turner and the Liberty groups of mounds in the Little Miami Valley, Ohio. The second mass was found near Catorze, San Luis Potosi, Mexico, in 1885. It weighs ninety-two pounds. Its composition (analysis by Mackintosh) is: $Fe = 90.09$; $Ni,Co = 9.07$; $P = 0.24$; schreibersite $= 0.60$. It resembles in character the irons of Augusta County, Va., of Glorieta[4] Mountain, and others of the class caillite (Meunier). In a cylindrical cavity in this meteor can still be seen the broken end of a copper chisel. ——The ninth meteoric iron which has actually been seen to fall has recently come into the possession of Mr. W. E. Hidden.[5] The mass weighed before polishing three thousand nine hundred and fifty grammes. It was seen to fall on the evening of the 27th of November, 1885, during the periodic star shower of the "Bielids." The location of the fall is near Mazapil, in the state of Zacatecas, Mexico. According to the belief of Professor

[1] Comptes Rendus, civ., Jan. 1887, p. 193.
[2] *Cf.* American Naturalist, Jan. 1887, p. 73; and Dec. 1885, p. 1213.
[3] Amer. Jour. Sci., xxxiii. p. 228.
[4] *Cf.* American Naturalist, Jan. 1887, p. 73.
[5] Amer. Jour. Sci., xxxiii., 1887, p. 221.

José A. y Bouilla, Director of the Astronomical Observatory at Zacatecas, this meteor represents part of the comet Biela-Gambert, lost since 1852. It is characterized by the freshness of its surface, which shows very perfectly the flow of the melted crust, and by the presence of unusually large nodules of a very compact graphite. For some time after its fall it remained red-hot. Its analysis yielded Mr. Mackintosh 91.26 per cent. of iron, 7.845 per cent. of nickel, 0.653 per cent. of cobalt, and 0.30 per cent. of phosphorus. Carbon is distributed all through the mass between the crystalline plates.——Mr. Huntington[1] calls attention to the fact that the Maverick County, Texas, meteorite[2] possesses many of the characteristics of the Coahuila irons, described by the late J. L. Smith, and from the similarity of the two concludes that the former must be classed as one of the latter, and should not be regarded as an independent fall.——In connection with meteorites it may be of interest to note the discovery by Meunier[3] of little globules of a stony matter in the ashes of Krakatau. Upon examination they are found to be made up of little crystals of augite and plagioclase in a vitreous ground-mass. The author calls attention to the similarity between these bodies and the chondra of certain meteorites.

Recent Publications.—It is unfortunate that a treatise written expressly for the use of students should contain so many inaccuracies as are noted in the recent "Elements of Geology" by Professor A. Winchell.[4] Whatever may be said of the rest of the book, that portion which treats of petrography and the optical properties of minerals will not serve to give the beginner any definite idea of the fundamental principles upon which all rock classification is now based. Many of the statements made are, to say the least, misleading, and the definitions of the various rock types are unsatisfactory.——An excellent text-book of Mineralogy, by Max Bauer,[5] appeared about a year ago. It is by far the best book for general use in the class-room that has yet been published. The chapters on the development of the principles of crystallography are to be recommended as especially well adapted to the use of those beginning the study of the subject.——Ferdinand Henrich's[6] text-book of Mathematical Crystallography will fill a long-felt want of those who desire to gain some knowledge of the methods in use for the measurement and calculation of crystal forms, crystallographic constants, twinning planes, etc. The work is well written, and the directions given in it are all clearly and concisely expressed. Wherever it can aid the explanation of a difficult point examples

[1] Amer. Jour. Sci., xxxiii., 1887, p. 115. [2] *Cf.* Amer. Naturalist, Jan. 1887, p. 73.
[3] Comptes Rendus, civ., 1887, p. 95.
[4] Geological Studies, or Elements of Geology. Chicago: Griggs, 1886.
[5] Lehrbuch der Mineralogie. Berlin und Leipzig, 1886. J. Guttentag (D. Collin).
[6] Lehrbuch der Krystallberechnung. Stuttgart, 1886. Euke.

are introduced and calculations are made in full, just as in ordinary practice. Miller's system of indices is used throughout, and the rules for making spherical projections are developed at some length. This is the only elementary text-book in which the subject of spherical projection is given the attention it naturally merits as being the method which is now almost universally used by the most eminent crystallographers.

Among the publications of the last few months which contain more or less of interest in mineralogy and petrography may be mentioned—

Professor A. Kenngott, M.D.—Handwörterbuch der Mineralogie, Geologie und Palaeontologie, III. Breslau, 1887. Eduard Trewendt.

Dr. C. Rieman.—Taschenbuch für Mineralogen. Berlin, 1887. Julius Springer.

F. Toula.—Mineralogische und petrographische Tabellen. Leipzig. Freytag.

J. D. Dana.—Manual of Mineralogy and Petrography.[1] 4th ed., 1887. New York: John Wiley & Sons.

Professor W. O. Crosby.—Tables for the Determination of Common Minerals, chiefly by the Physical Properties, with confirmatory Chemical Tests.[2] Boston, 1887. A. Crosby.

Professor A. H. Chester.—Catalogue of Minerals Alphabetically Arranged, with their Chemical Composition and Synonyms.[2] New York, 1886. John Wiley & Sons.

T. Sterry Hunt.—Mineral Physiology and Physiography.[2] Boston, 1886. S. E. Cassino.

Professor W. O. Crosby.—Geological Collections. Mineralogy. Boston Soc. Nat. History, 1886.

A. C. Lawson.—Report on the Geology of the Lake of the Woods Region. Part CC. Annual Report of the Geological and Natural History Survey of Canada. Montreal, 1885.

C. D. Lawton.—Mineral Resources of Michigan for 1885. By authority. Lansing, 1886. Thorp & Godfrey.

Mineral Resources of the United States for 1885. Washington, 1886. Government Printing Office.

Dr. P. Groth.—Grundriss der Edelsteinkunde. Leipzig, 1887. Engelmann.

BOTANY.[3]

A Couple of Botanical Estrays.—A botanical discovery of some interest has recently been made in the neighborhood of Iowa City. Two species of Lycopodium have been found. So far as the writer can learn, this is the first record of such plants within the limits of Iowa. Lycopodium has been sought in all

[1] Reviewed in Science, 1887, p. 304.
[2] Reviewed in Science, February, 1887, p. 142.
[3] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

directions, but hitherto is not reported anywhere west of the Mississippi River, south of Pine County, Minn. The discovery is the more interesting when we know that the two species found, grow side by side within the limits of a very narrow area. A space ten by fifteen feet includes the entire station. All the hill-sides in the vicinity were searched in vain for other specimens. The plants did not fruit last year, are feeble, depauperate specimens of their species, and probably destined now to speedy extinction. The few white oaks, remnants of the "forest primeval," which have long afforded shelter, are now cut away, the hill-side becomes a pasture-field, and Lycopodium will be found no more.

To account for this isolated station, this peculiar distribution, is not easy. One is reminded of Scolopendrium, Shortia, and the like. Probably other stations will be found to the north which may serve to put these little specimens in geographical connection with their kin. This can hardly be the last tarrying-place of a plant which must at one time have covered all the northern portions of the State.—*T. H. McBride, Iowa City*, May 7, 1887.

The Origin of the Tomato from a Morphological Standpoint.[1]—There are two methods by which the cultivator can determine the origin of vegetables which have been long in cultivation. He can follow the history of the plant to its introduction into gardens and may then be able to identify it with a wild species, or he may reason from inference from the morphology and direction of variation of the plant in hand. The latter method may be illustrated by the tomato.

I will suppose, for my purpose, that no record exists as to the introduction of the tomato, or in regard to its characters, at any time before the present.

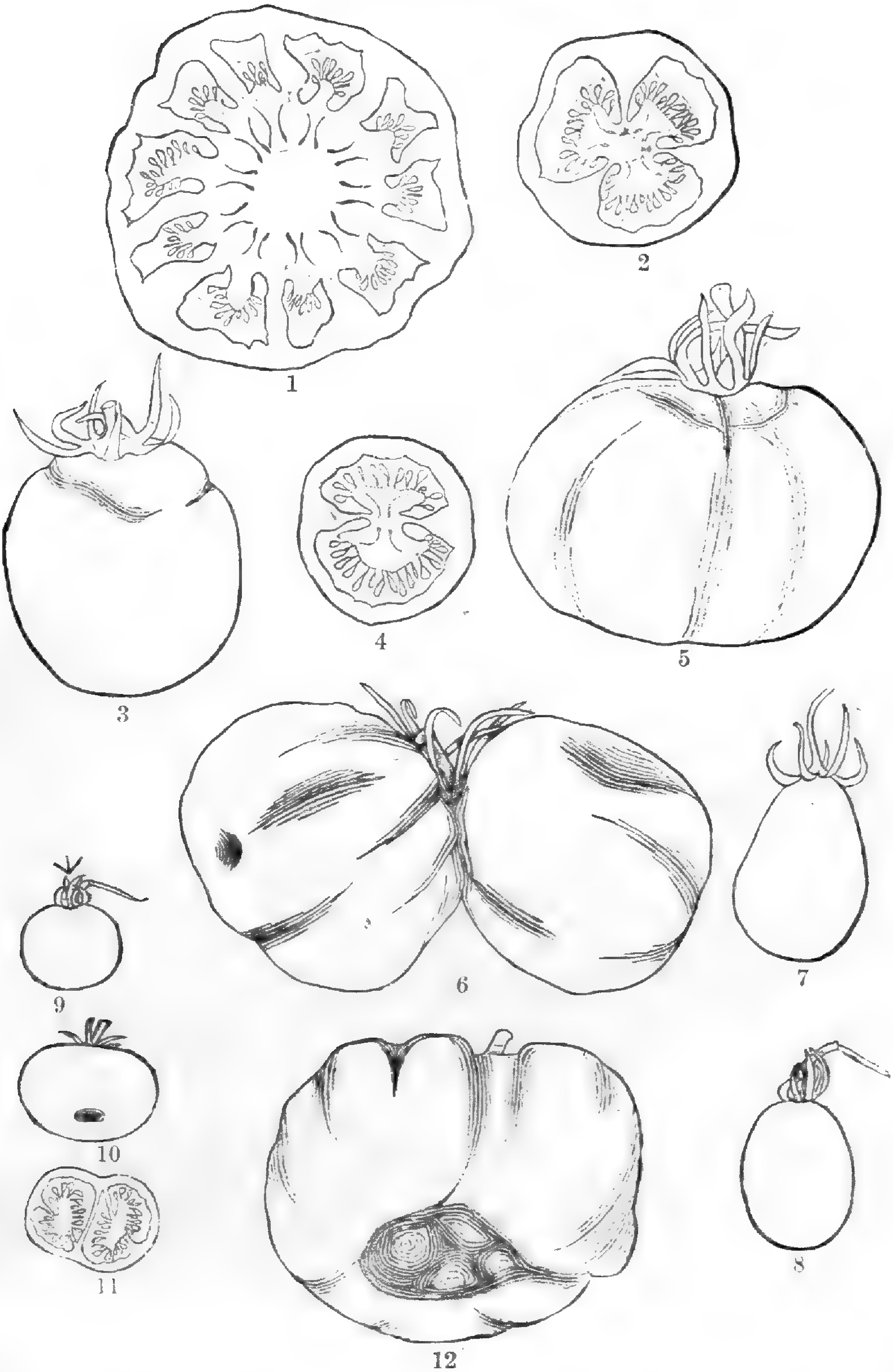
The fruit of the large tomato is seen at once to be extremely variable. This variability lies mostly in size, form, and number of cells. The number of cells, as seen in a cross-section of the fruit, may be taken as a measure of size and form. Fig. 1 represents a cross-section in which ten partial cell-divisions project from the walls of the fruit. This is a section of a Trophy. If we were to examine a hundred specimens of this variety we should find no two alike in shape and number of cells, and, consequently, in shape and size of fruit. Moreover, we should find the variations to be very great. Now, fruits in wild nature possess a definite number of cells, and of definite shape. The Trophy, then, is a monster; it is unnatural. To find a fruit nearer the original wild type we must find one more constant in its character. We examine critically every large-fruited sort,

[1] This paper is a revision and extension of one which first appeared in the *American Garden*.

and we find each one monstrous in regard to form and number of cells, but some are less so than others. The least monstrous are always those with the fewest cells. The fewest-celled fruits in our culture, then, must be nearest the original type. Fig. 2 represents a sectional view of a normal Criterion. The cells are three, incomplete. The fruit, Fig. 3, is oblong, mostly regular. The smallest, most regular specimens of this variety are incompletely two-celled, Fig. 4. On the other hand, abnormal specimens of this variety are many-celled, as shown by the partially-lobed fruit in Fig. 5. Occasionally the tendency to monstrosity extends to the flowers, and a twin is the result, Fig. 6. The Criterion presents nearly the whole record of development within itself. Its regular, small, normal, two-celled fruits approach the original type. Figs. 5 and 6 attest an excessive influence of cultivation. All the fruits here represented grew upon the same plant. The Criterion must be compared with the pear-shaped and egg-shaped sorts. Fig. 7 represents one of the Pear tomatoes. It is almost uniformly two-celled, or, in its larger form, the King Humbert, it becomes three-celled, and connects completely the Pear tomato and the Criterion. Below the Pear in point of development is the Plum tomato, Fig. 8. It approaches more nearly a spherical form, and is almost uniformly two-celled. Still lower is the Cherry tomato, Fig. 9,—the smallest and simplest of them all, and two-celled. This is our nearest approach to the wild type. The first tomato known to man could have been little else than this Cherry tomato. Here the cell-division is perfect, and gives every evidence of being normal. The first tomato must have been a two-celled fruit, and its shape spherical, or nearly so. The Pear tomatoes are also completely two-celled, —that is, the cell-division extends entirely across the fruit,—and this gives us reason to suppose that they may have existed in wild nature also. Granting this, they nevertheless give evidence of development from the Cherry tomato, as we have seen from the intermediate Plum varieties, Fig. 8. In cultivation they present fewer constant specific marks than the Cherry sorts.

Occasionally, however, the Cherry tomato broadens, as in Fig. 10, and becomes more or less completely three- or four-celled, Fig. 11. This figure shows the complete cell-division which separates the normal tomato into halves. This variation is the beginning of the flat and angular tomatoes. Small developments from it are Green Gage, Improved Large Yellow, and White Apple. As the fruits increase in size by the interposition of new cells, they take on abnormal shapes. Adventitious cells are often pushed into the centre of the fruit, giving rise to the familiar structure represented on the top of Fig. 12. Often the rupture caused by these adventitious cells takes the form of an irregular line rather than a ring, as in the illustration. Most of the large varieties of tomatoes give unmistakable evidence of development

PLATE XVIII.



from the Cherry tomato. So obvious is the direction and manner of variation in the tomato that among seventy-five varieties grown in our gardens last year there were none which refused to be classified, in relation to their origins and tendencies, as to whether the earliest variations had been directly from the Cherry tomato or through the Pear tomato. So clear does this manner of variation become, after a few weeks of study, that I am compelled to place more confidence in this method of ascertaining the origin of our cultivated tomatoes than in the records of old herbals.

We cannot so positively determine the color of the original tomato. Five-sixths or more of all our tomatoes are in various shades of red. From this fact we infer that red is the strongest and prevailing, hence the original, color.

The classification of cultivated tomatoes, upon morphological principles, may be represented as follows:

LYCOPERSICUM ESCULENTUM Miller, "Gard. Dict." (1768).

§ A. *Cerasiforme.*—Cherry tomatoes (*L. cerasiforme* Dunal, "Hist. Solan.," 113). Fruit spherical, two-celled,—the original type.

§ B. *Pyriforme.*—Pear and Plum tomatoes (*L. pyriforme* Dunal, l. c., 112). Fruit oblong or pyriform, two-celled, conspicuously pendent.

§§ A. *Vulgare.*—Plant weak, requiring support; leaves ordinary.

Group 1. Angular tomatoes. Fruit medium or below in size, mostly very flat, plane on top, more or less cornered, the lobes most conspicuous on the bottom and sides. Developments directly from the Cherry tomato, through the type of Improved Large Yellow, etc. Tom Thumb may be taken as the type of the group.

Group 2. Apple-shaped tomatoes. Fruit normally more or less rounded on top, most of the irregularities being due to the interposition of adventitious cells in the centre of the fruit. Direct developments from the Cherry tomato, through its longer and more regular forms. The "ringed" or "lined" character of the apex of the fruit is oftenest seen in this group. The Paragon may be taken as a type of the group.

Group 3. Oblong tomatoes. Fruit usually as long or longer than broad, the sides very firm. Developments from the pear-shaped variation. Criterion, in its normal forms, may be considered the type.

§§ B. *Grandifolium.*—Habit the same as in sub-section A; leaves very large; leaflets fewer (about two pairs), large (the blade three to four inches long and an inch and a half wide), entire, the lower side strongly decurrent on the petiolule. Leaves of very young plants are entire! Singular plants of recent development, represented by but few varieties, of which Mikado may be taken as type.

§§ C. *Validum.*—Stem very thick and stout, the plants nearly sustaining themselves; two to three feet high; leaves very dark green, short, and dense, the leaflets wrinkled and more or less recurved. Odd plants, with the aspect of potatoes, represented by French Upright and the New Station.

Another species, *Lycopersicum pimpinellifolium* Dunal, "Solan. Syn.," 3, the Current tomato, is cultivated as a curiosity.—*L. H. Bailey, Jr., Agricultural College, Mich.*

Experiments with Lima Beans in Germination.[1]—After reading some of the suggestive writings of Darwin, I began a few experiments with some Lima beans. About forty seeds were planted in the damp sand placed in a cellar. Of these twenty were placed on edge with the scar or hilum downwards, and twenty in a reverse position with the hilum uppermost.

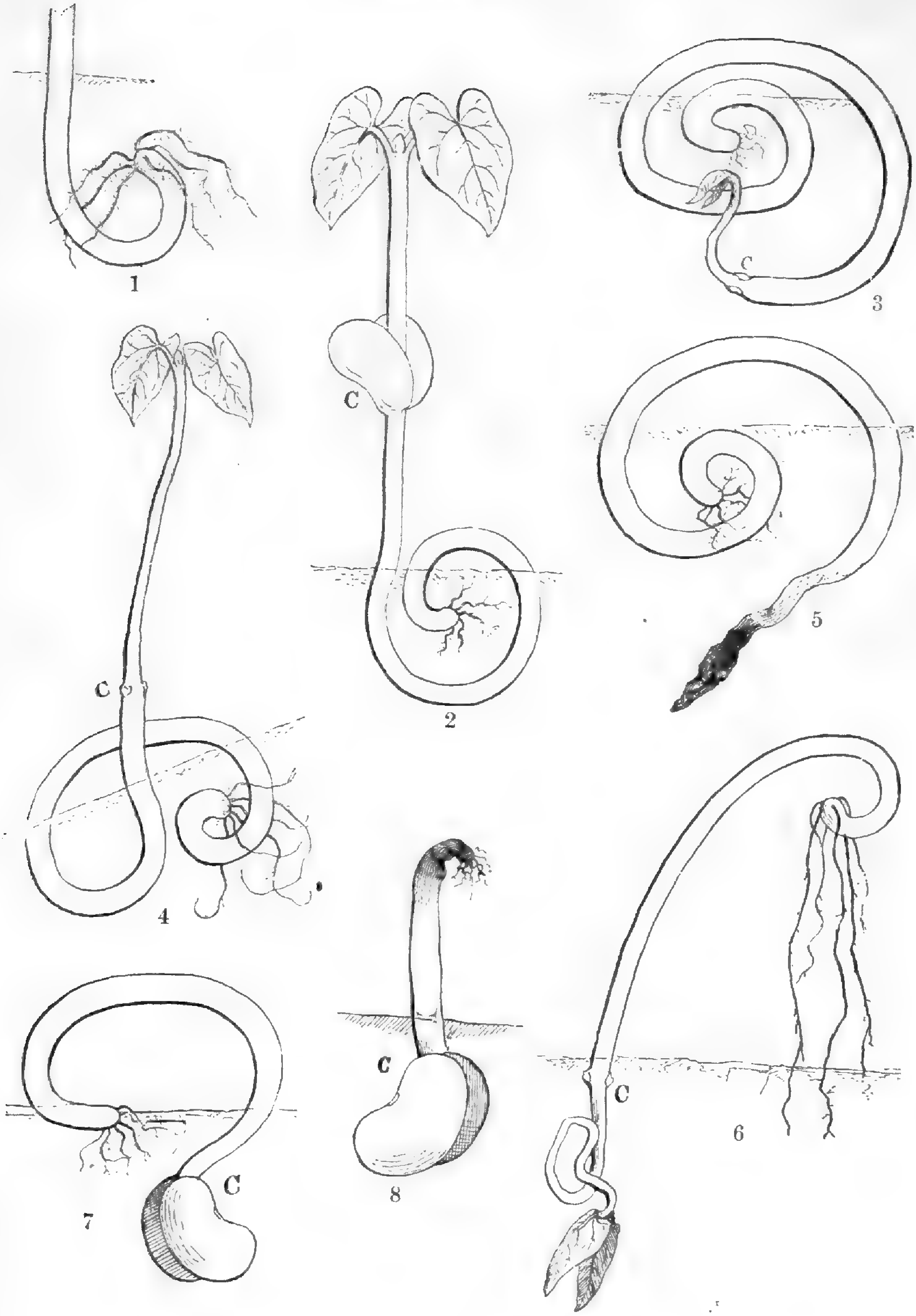
In most cases seeds of this species, when germinating, produce a long radicle, which carries the cotyledons some inches above ground. In this case two seeds produced a very short radicle,—perhaps half an inch long,—so that the cotyledons remained beneath the surface, as is usually the case with germinating peas. The beans planted with the eye down behaved well and came up promptly, all of them, while those placed in the reverse position went through with a great variety of manœuvres, and even then some of these perished in the attempt to make young plants. After some delay a considerable portion of them came out of the ground. Most of these bent the radicle into a half-circle, or, rather, that of an ox-bow, with one arm much longer than the other, carrying up the cotyledons. In making growth in the cellar nearly all of the young plants sent from one to several roots above the surface, where they usually re-entered the sand.

Four out of the twenty with the scar-edge up, after exhausting the nourishment stored in the cotyledons, perished in their attempts to make a successful growth. The lengthening radicle arched up out of the sand, but the plumule finally decayed.

In the sandy soil of my garden were placed twenty-five seeds in the manner last mentioned. A few came up very promptly, but for some time most of them seemed to rest beneath the sur-

[1] Read at the Montreal meeting of A. A. A. S. in 1882, and only a very brief abstract printed, without illustrations.

PLATE XIX.



face; but a week of rainy weather brought most of the rest to the surface in some form or other. Nine out of twenty-five sent the lower end of the radicle, with its roots, from three-fourths to two and one-half inches above the surface. The plumule for a time remained green, and the cotyledons were not yet exhausted; but in time all of these perished without bringing any green leaves to the surface.—*W. J. Beal, Agricultural College, Mich.*

EXPLANATION OF THE PLATE.

No. 1. The first of those to come up, where the hilum was placed uppermost, usually took the form of this figure.

No. 2. This represents one of those in which the hilum was placed uppermost.

No. 3. In this case the seedling is still struggling to send its plumule to the surface. The cotyledons, which were attached at C, have been rubbed off by the movements of the young plant through the sand.

No. 4. One plant is here represented in which the partially-exhausted cotyledons had been rubbed off.

No. 5. This represents one specimen in which the cotyledons have disappeared and the plumule has decayed.

No. 6. In this case the cotyledons have disappeared; the plumule and primary leaves were still green; some of the roots were still fresh in the soil, though the lower end of the radicle was elevated nearly three inches above the surface of the sand.

No. 7. Six out of twenty-five planted in open ground with the hilum uppermost were much like this figure, and likely to succeed in becoming good plants.

No. 8. Nine out of twenty-five planted as above in the open ground thrust the radicle with its roots nearly straight up out of the soil, sometimes as much as two and one-half inches, when the seedlings perished.

[All the figures were made by Will. Holdsworth.]

ENTOMOLOGY.[1]

Note on Respiration of Aquatic Bugs.—Among the most common insects found in our smaller ponds are those popularly known as "Water-Boatmen." Of these, the more abundant species pertain to two genera,—*Corisa* and *Notonecta*. In each of these genera the insect carries about with it, in its course through the water, a bubble of air, which it uses for respiration. At one time I kept for a considerable period several aquaria containing these insects upon the table where I was working. Some interesting phenomena connected with their respiration attracted my attention. Other duties interfered with the completion of my observations, and I now publish this note merely to call the attention of other observers to the subject.

The habits of the two genera are very different. In each the insect comes to the surface of the water at intervals to obtain a supply of fresh air; but in the case of *Corisa*, inhabiting well-aerated water, this does not seem to be absolutely necessary. The favorite attitude of the species of this genus when at rest is clinging to some object near the bottom of the aquarium; here they will remain for long periods, evincing no desire to rise to

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

the surface. The ventral aspect of the body at such times is covered with a film of air; and the space between the head and prothorax, and that between the prothorax and mesothorax, are also filled with air, as well as a space beneath the wings. But the quantity of air thus carried about by the insect is insufficient to account for the long period during which it remains beneath the surface of the water. By observing a *Corisa* when anchored near the bottom of a pond or aquarium, it will be seen that it clings by means of its anterior legs, and that the posterior legs are extended laterally and are frequently moved as when swimming. The result of this movement is to cause a current of water to pass over the film of air on the ventral side of the body. In this way the air may be purified as if in a tracheal gill. I was confirmed in the opinion that this air-film functions as a tracheal gill in two ways: first, when the water in which these insects were kept was allowed to become impure they became uneasy and frequently came to the surface for fresh supplies of air; second, in the case of *Notonecta* (the water-boatmen that swim upon their backs) the greater part of the air is carried beneath the wings; thus it comes in contact with the water but little, and is not, therefore, purified to any considerable extent by the free gases in the water. Correlated with this are habits very different from those of *Corisa*. The *Notonecta*, when at rest, almost invariably floats with the tip of its abdomen projecting from the water, in order that it may easily change the air under its wings.

In order to demonstrate the necessity for *Notonecta* to come to the surface frequently, I placed specimens in a closed vessel through which fresh water was allowed to run, but so arranged that the insects could not reach the open air. They made frantic efforts to push the tips of their bodies from the water. Failing in this, the air from beneath the wings in some way was accumulated on the ventral side of the body, where it at first formed a bubble of considerable size. This bubble was kneaded by the legs, and thus broken up into many small globules interspersed with water. After this the air was pushed back to the tip of the abdomen, and was again drawn under the wings. Thus it seems that the *Notonecta* can, in an emergency, avail itself of a method of purifying its supply of air, which, with the *Corisa*, is normal. I doubt, however, whether the *Notonecta* could keep itself alive in this way for a long period.—*J. H. Comstock.*

Pedigree Moths.—In a paper upon "Pedigree Moths," read before the London Entomological Society, February, 1887, Mr. Francis Galton, F. R. S., explained the plan and object of his proposed experiments in breeding moths, with the view of obtaining certain hereditary data needed to confirm results gained in the course of previous experimental research, when other subjects than moths were treated. Mr. Galton says, "It is intended, in each case, to procure broods through a succession of selected specimens, along three lines of descent from a single pair of individuals, so that there will be three parallel broods in each generation. The particular characteristic that is selected for these experiments must admit of being accurately measured; in other respects the choice is immaterial. For brevity of explanation, I will suppose it to be size; then, starting from the brood of the original pair, (1) a few of the largest of either sex would be separated and mated; out of their progeny a few of the largest would again be taken and mated, and so on, for several generations. (2) Exactly the same process just described would be gone through, after substituting throughout the words 'medium-sized' for 'largest.' (3) Similarly, after substituting the word 'smallest' for 'largest.' The result will be to obtain a precise measure of the diminution of rate at which a divergence from the average of the race proceeds in successive generations of continually-selected animals."—*Entomologist*, vol. xx. p. 60.

Ears of Insects.—A correspondent calls attention to the statement made by Professor Packard, in the March number of this magazine, that locusts and grasshoppers have been "proved" to have ears. In opposition, he quotes from Dr. C. S. Minot's "Comparative Morphology of the Ear" (*Am. Jour. Otology*, iv., April, 1882), as follows: "All attempts, however, to demonstrate the existence of an auditory organ in insects have hitherto failed. The only organs which might be interpreted as answering functionally to an ear are the so-called tympanal organs of Orthoptera; but it has not yet been demonstrated that these peculiar structures do really subserve the sense of hearing." After an abstract of Graber's researches on these organs, Dr. Minot concludes, "The preceding accounts show that we have to do with unquestionable sense-organs, although of a very unusual character. . . . As to their probable functions, we possess no satisfactory indication; but it seems particularly improbable that they are auditory organs." And again, "It is certain that they are of much importance, but their physiological rôle is, we repeat, unknown."

Relations of Ants and Aphids.—As bearing upon our note on this subject in the NATURALIST for April, Professor Forbes writes as follows: "I find that, by leaning too heavily upon a considerable amount of negative evidence collected last year and the year preceding, I made an error last summer in the life-history of the corn plant-louse, *Aphis maidis.* We have succeeded this spring in finding the eggs of this species in the nests of *Lasius alienus*, in fields of corn infested by the lice the previous year, have hatched these eggs in the office, and have reared them upon corn-roots exposed in glass tubes until all question of their specific character is removed. We also find that the ants rear the young, before the ground is planted, upon the roots of *Setaria* and *Polygonum*, common weeds in the fields, transferring them afterwards to the young corn. I judge, from the activity of the ants and the arduous character of their labors in the spring, before the plant-lice have become available as a means of subsistence, that they have independent resources. In a single instance we found dead *Bibio albipennis* dragged into the nest; but, like so many other insects at this season, the ants probably feed largely upon the fluid exudations of plants."

Exposition of Insects.—There will be held in Paris, beginning on the 27th August and lasting until 28th September, 1887, an exposition of useful insects and their products, and of noxious insects and specimens of their injuries. This exposition is conducted by the Société centrale d'Apiculture et d'Insectologie, under the patronage of the Ministre de l'Agriculture. There is also to be given in this exposition a place for insecticides, and various devices for destroying insects. It is to be opened to foreign as well as French exhibitors.

Entomological News.—Mr. L. O. Howard gives, in the *Transactions of the American Entomological Society*, vol. xiii. pp. 169–178, a generic synopsis of the *Proctotrupidæ*, based upon that which appears in Dr. Foerster's "Hymenopterologische Studien." The synopsis includes one hundred and thirteen genera, of which twenty-nine are represented in this country; these are indicated by an asterisk.——In the same volume, p. 179, Mr. Charles A. Blake gives a monograph of the *Mutillidæ* of North America. The genera, and also the species, are separated by analytical tables. Many new species are described, bringing the number of known species up to about one hundred and thirty.——Williston also gives (l. c., p. 308) a catalogue of the described species of South American *Syrphidæ*. About three hundred species, representing about forty genera, are enumerated.——Dr. Gustav Mayr publishes a paper on the ants of the United States of America, in the *Verh. k. k. Zool.-Bot. Ges. in Wien*, pp. 419–468. This paper is a synonymical and descriptive list of forty-eight pages, in which one hundred and seven species, representing thirty-four genera, are given. Fourteen new species are described.——Mr. Grote has published, in Bremen, a small work on the "Hawk-Moths of North America." ——Dr. Riley has published Bulletin No. 10 of the Division of Entomology, U. S. Dept. Agr., entitled "Our Shade-Trees and their Insect Defoliators, being a consideration of the four most injurious species which affect the trees of the Capital, with means of destroying them." The imported elm-leaf-beetle, the bag-worm, the white-marked tussock-moth, and the fall web-worm are the insects discussed.——The *Proceedings of the Natural History Society of Wisconsin* for April devotes forty-two pages to a paper on the special senses of wasps, by G. W. and E. G. Peckham.

ZOOLOGY.

The Fauna of Liverpool Bay.—A short time ago, at the instigation of Professor W. A. Herdman, of Liverpool, England, the "Liverpool Marine Biological Committee" was formed, the object of which was to explore the fauna of Liverpool Bay and the adjacent seas. The first report of this committee has recently been published, and occupies three hundred and seventy pages, with ten plates and two maps, of vol. xl. of the "Proceedings" of the Liverpool Literary and Philosophical Society. Persons interested loaned tugs and steamers for the purposes of dredging, and the additions made to the knowledge of the fauna of the Irish Sea are very considerable. The specimens collected were turned over to specialists to work up, and from their reports and lists of species it has been found that of the nine hundred and thirteen species recorded, two hundred and thirty-five were new to the region embraced; sixteen were never before reported from the British seas, and of these seven species and three varieties are new to science. Of the special reports on the different groups we can only allude to Professor A. Milne Marshall's excellent sketch on shallow-water faunas, and that of the Rev. H. H. Higgins on pioneers in local biology. Professor W. A. Herdman in a supplementary paper deals with variability in the tunicates, while J. H. Gibson discusses the systematic value of the spines of the polychætous worms, coming to the conclusion that they are of but moderate importance. There are a few notes on the attempted introduction of the quahog (*Venus mercenaria*), which does not appear to have been successful. Among the projects outlined for the future is a systematic examination of the fauna between tide-marks. This littoral zone is to be divided into belts, corresponding to its elevation above low-water mark, and each belt is to be examined separately with a view of ascertaining, among other points, the daily submergence which each species requires.

The Systematic Position of the Sponges.—Dr. G. C. J. Vosmaer, in the concluding portion of his volume on the Porifera in Bronn's "Klassen und Ordnungen des Thierreichs," discusses the various views held as to the relationships of the sponges, and advances some ideas of his own, which, from his familiarity with the subject, are worthy of attention. He divides the sponges into two great groups, Calcarea and Non-Calcarea, maintaining that the two are perfectly distinct, and that there are no osculant forms. He divides the Non-Calcarea into Hyalospongiæ (= Hexactinellidæ *Auct.*), Spiculispongiæ, and Cornacuspongiæ, the limits between which are not so distinct as those between the groups first mentioned.

As to the origin of the sponges, Vosmaer claims that our embryological knowledge is still insufficient to decide, but still that there is some reason for the belief that their ancestor was a free-swimming form, which may have been like the larva of some silicious sponge. The larva of Sycandra is too aberrant to hold the position of representative. First to be settled is the point whether the sponges are to be regarded as Protozoa, Cœlenterates, or an independent group. Vosmaer takes the latter view, and quotes in support Balfour, Heider, Bütschli, and Sollas, but fails to refer to Hyatt, who antedates them all in holding this opinion. His reasons are both structural and embryological. He fails to see that the sponges are degenerate Cœlenterata,—as is held by most continental students,—and claims that while the silicious sponges are degenerating, the Calcarea and the Cornacuspongiæ are advancing. In development the Spongiæ and the Cœlenterata have nothing in common beyond the gastrula stage. That the sponges have indirectly descended from the Protozoa Vosmaer thinks probable, but he is at a loss for the transition stages, as he does not accept the views of the late Henry James Clarke, which, by the way, he attributes to Saville Kent. Balfour's amphiblastula theory is dismissed with few words as set aside by Heider, while Heider's own theory receives scarcely more mention. For himself he has now new ideas to advance. He thinks that the first sponges were deep-sea forms, and ultimately developed a stony silicious skeleton, which degenerated to at least a considerable extent when the forms entered shallower cases.

Parasitic Sea-Anemones.—Prof. A. C. Haddon enumerates (*Sci. Proc. Roy. Dublin Socy.*, v. pp. 473–481, 1887) the known parasitic larvæ of the genera variously known as Bicidium, Peachia, Philomedusa, and Halcampa. This group is known on our coast by a form first described by Mr. Alexander Agassiz as *Bicidium parasiticum*, but which has since been referred to the two genera Peachia and Philomedusa, the latter of which will now have to lapse into synonymy. *Peachia parasitica* is a small sea-anemone an inch or two in length, which is usually formed, as its name implies, parasitic in the folds around the mouth of the large brown or purple jelly-fish, *Cyanea arctica*. Haddon has some remarks on the number of tentacles and mesenteries in these forms, which lead him to the conclusion that the three families in which these parasitic sea-anemones occur are more closely related than is usually thought to be the case. A detailed account of the British species of Halcampa is promised.

Chætonotus.—Dr. A. C. Stokes has catalogued the American and some of the foreign species of Chætonotus in the *Microscope* (vol. vii. pp. 1 and 33, 2 pls., 1887). Of the species twenty are enumerated. *Chætonotus sulcatus, concinnus, loricatus, rhomboides, spinifer, acanthodes, octonarius, spinulosus, longispinosus, enormis,* and *acanthophorus* (11) are described as new from New Jersey. *Ch. podura, maximus,* and *larus* of Ehrenberg are regarded as common to both Europe and America, while the other six species catalogued have not been seen by this observer in America. The paper is preceded by a few notes on their anatomy and a few observations upon their eggs, which pass through their development, from segmentation to hatching, in thirty hours. Dr. Stokes, it may be said in passing, unites Ichthydium with Chætonotus, a step of doubtful propriety, while no mention is made of the other genera of the class Gastrotricha, to which these worms belong. Dr. Stokes's paper has been reprinted in Pelletan's *Journal de Micrographie.*

Anatomy of Pseudoscorpions.—Croneberg gives (*Zool. Anzeiger,* No. 246) a preliminary account of the anatomy of Chernes, one of the Pseudoscorpions. The sucking pharynx is moved by dilator muscles, the contraction being effected by the elasticity of the strongly chitinized wall. The œsophagus is narrow, but widens out for the short stomach, and then at once contracts to form the intestine. With the stomach are connected the three (one medium, two paired) hepatic sacs, the lateral ones being divided into eight secondary lobes. The unpaired and inferior sac, among other substances, secretes a chalky-white substance which forms the exclusive contents of the intestine. The brain, heart, and genitalia are described. Croneberg, however, could find no traces of the spinning-glands described by Menge as occurring at the tip of the abdomen, where indeed he thinks it would be poorly adapted for the animal's needs. Croneberg rather seeks the spinning organs in two glands above the brain, the ducts of which terminate at the tips of the movable joints of the cheliceræ. Menge claims to have witnessed these animals spinning their small protective webs, but this Croneberg does not appear to have seen.

Description of a New Species of Fruit-Pigeon (*Janthænas jouyi*) from the Liu Kiu Islands, Japan.

Janthænas jouyi, sp. nov.

Diagnosis: Similar to *Janthænas ianthina* (Temm.), but with a large white patch on the lower hind neck and the anterior portion of the interscapilium; metallic reflections on scapulars and back bronzy green, not purple as in *J. ianthina.*

DIMENSIONS: Wing, 253 mm.; tail-feathers, 188 mm.; exposed culmen, 23 mm.; tarsus, 35 mm.; middle toe, with claw, 51 mm.

SYNONYMY: *Carpophaga ianthina* Seebohm, Ibis, 1887, p. 179 (*part*).

HABITAT: Liu Kiu Islands, Japan.

TYPE: Tokio Educational Museum, C. Tasaki coll., February 3, 1887.

Other specimens of this very distinct species have been obtained by Mr. H. Pryer's collectors in the Liu Kiu Islands. I take great pleasure in dedicating it to my friend, Mr. P. L. Jouy.

I wish also to express my indebtedness to the authorities of the Tokio Educational Museum for the opportunity to describe this interesting novelty.—*Leonhard Stejneger.*

Zoological News.—PROTOZOA.—J. H. Siddall, in his report on the Foraminifera of the Liverpool Marine District (*supra*), gives the following account of the method of collecting these forms. Foraminifera, he says, "may always be got by carefully scraping the surface of the velvety brownish mud at the bottom of pools left by the tide. . . . The oozy mud may be got rid of by washing through a fine muslin net, and the residuum put into small bottles filled with sea-water. The bottles should be kept uncorked in a cool place, out of direct sunlight, when the Foraminifera will creep up the sides of the bottle and live there for months."

SPONGES.—Prof. P. Martin Duncan and Dr. G. J. Hinde are having an animated discussion in the pages of the *Annals and Magazine of Natural History* over the name to be applied to the fossil sponge Hindia of Tennessee.

Mr. H. J. Carter (*Ann. and Mag. N. H.*, April, 1887) describes a new species of fleshy sponge from Australia under the name *Chondrosia spurca*, which is remarkable from the immense amount of foreign material (more than half its bulk in one instance) which it incorporates in its tissues.

VERTEBRATA—FISHES.—*Linophryne lucifer*, recently described in the *P. Z. S. of London*, by Robert Collett, is a singular, small Ceratian with an enormous head and mouth, a single cephalic tentacle to represent the spinous dorsal; immensely long and slender teeth on the jaws and vomer (also teeth on upper pharyngeals); very narrow gill-openings; very short soft dorsal and anal, and no ventrals. The abdominal cavity forms a sac suspended from the trunk, and projecting backward beyond the tail. There is a long tentacle on the throat. The specimen was taken off Madeira.

G. A. Boulenger has recently described a Ctenopoma, a Clarias, and a Mormyrus, from the Lower Congo. All have native names; also three new South American Characinoids.

Reptiles and Batrachia.—Mr. G. A. Boulenger describes a new Calamaria, from Borneo, in the *Annals and Mag. Nat. Hist.* (March). He also notes that *Elaphis grabowskyi* Fischer, from Southeastern Borneo, is identical with *E. tæniurus* Cope. The latter snake has a wide range, since specimens have been obtained from Pekin, Darjeeling, Siam, and Sumatra.

Mr. G. A. Boulenger makes some remarks (*Ann. and Mag. Nat. Hist.*, March) upon the fresh-water turtle recently described by Mr. E. P. Ramsey in the *Proc. Linn. Soc. N. S. W.* This tortoise (*Carettochelys*) was obtained in the Fly River, New Guinea, and is stated to be one of the most striking discoveries made in recent herpetology during the last twenty years. It differs from all fresh-water turtles by the structure of the limbs, which form regular paddles, and have only the two inner digits clawed. Epidermic scutes are absent. Mr. Boulenger makes it the type of a family of Pleurodira,—Carettochelydidæ.

G. A. Boulenger has recently described *Rana martensii*, from Japan; *Ixalus asper*, from Perak; and *Geomolge fischeri*, from the river Ussuri, in Mantchuria. Also a new frog, of the genus Megalophrys, from Perak.

Birds.—Mr. F. E. Beddard states that the air-sacs of Casuarius resemble those of Apteryx much more closely than those of Rhea.

The same anatomist has examined the structure of the syrinx in various Caprimulgidæ. Though the Guacharo (Steatornis) stands alone in having a purely branchial syrinx, yet Podargus and Batrachostomus are transitional between Steatornis and other Caprimulgidæ.

Those interested in pterography will find, in the *Proceedings Zool. Soc. London*, April, 1886, a valuable paper, with illustrations, upon the disposition of the cubital coverts. Mr. Goodchild remarks that, up to a certain point, there is a remarkable correlation of particular styles of imbrication of the cubital coverts with certain structural peculiarities,—osteological, myological, visceral, and pterographical.

Mr. H. B. Tristram (*P. Z. S.*, January, 1886) describes *Dafila modesta*, a fourth species of the genus, from Sidney Island, Phœnix Group (lat., 4.30° S.; lon., 171.20° W.).

Mr. P. L. Sclater has described a new flamingo (*Phœnicopterus jamesi*), from Tarapaca, Chili. Three specimens were obtained by Carlos Rahmer, at a height of about twelve thousand feet, at the foot of the Tsluga Volcano. The bill is shorter and smaller than in *Ph. andinus*, the naked space at the lores wider, the upper mandible narrower, and there is less black at the tip. The legs of the species are red.

Mammals.—The British Museum has lately received, along with the magnificent collection of East Indian birds donated by

Mr. A. O. Hume, about four hundred examples of mammals, referable to two hundred and six species. The collection is geographically valuable, since it comprises four separate series, obtained, respectively, at Sambhur in Rajpootana, Manipur (northwest of Birmah), Tenasserim, and the Malay Peninsula. Sambhur fixes the limit at which the fauna begins to lose its ordinary Indian character, and to show signs of the desert character of Sinde and the Punjab. *Felis chaus*, *F. torquata*, *F. ornata*, *Viverricula malaccensis*, *Paradoxurus niger*, *Herpestes griseus* and *H. smithii*, and *Mellivora indica* occur among the specimens. The Manipur fauna is decidedly Himalayan. A new variety of *Herpestes auropunctatus* and a new Mus. (*M. humei*) are the novelties, and *Sciurus indicus* has its known range extended from Nepal to Manipur. *Semnopithecus femoralis* is added to the Tenasserim fauna, and among the Malay specimens is a beautiful new Sciuropterus (*S. davidsoni*).—*P. Z. S.*, January, 1886, Mr. O. Thomas.

Mr. R. A. Sterndale notes the certain occurrence of a natural hybrid between *Ovis hodgsoni* and *O. vignei*, due to a ram of the former and larger species appropriating the ewes of a herd of the latter. The ram was killed by wolves, and in course of time the hybrids, crossed with *O. vignei*, showed signs of reversion to that type.

Part I. of vol. clxxvi. of the *Philosophical Transactions of the Royal Society of London* contains two portions of W. K. Parker's work upon the structure and development of the skull in the Mammalia. The first part is devoted to the Edentata, the second to the Insectivora. Thirty-nine plates illustrate these treatises.

Mr. O. Thomas describes (*Ann. and Mag. Nat. Hist.*, February) *Pseudochirus forbesi*, a new Papuan phalanger similar to *Ps. canescens* Waterhouse. An adult male was 280 mm. long without the tail, which measured 230 mm. It was found in the Astrolabe Mountains of Southeastern New Guinea, at a height of two thousand feet.

Mr. Thomas also diagnoses *Nesonycteris woodfordi* and *Pteropus grandis*, two new fruit-eating bats from the Solomon Islands.

Dr. Monticelli contributes to the *Proceedings of the London Zoological Society* a list of the South Italian Chiroptera, including eighteen species.

Mr. O. Thomas has described and figured, in the *Proc. Zool. Soc.*, two skulls of *Mustela pennantii*, which, though both adult, exhibit variations such as have often given foundation for the description of new species. The development of the temporal muscles has expanded the zygomatic arches, absolutely constricted the anterior part of the skull, and narrowed the posterior narial passage in the older skull.

One of the most singular of rodents is *Heterocephalus phillipsi*, from Somali-land. It is of about the size of a mouse, but, from its hairless skin, small eyes, and peculiar head, looks more like a tiny puppy. The ears are simple, round holes, without a conch, and the eyeballs are barely half a millimetre in diameter. Another species, *H. glaber*, was described by Rüppell forty years ago. It is a burrower, the skin passing across the mouth inside the incisors.

EMBRYOLOGY.[1]

Suggestion respecting the Epiblastic Origin of the Segmental Duct.—In a recent paper[2] with the above title, Prof. A. C. Haddon, of Dublin, offers a very suggestive explanation of the origin of the paired parallel segmental ducts of vertebrates from lateral, longitudinal grooves in some primitive, ancestral form, these grooves finally closing so as to form lateral ducts, which, at last, became confluent posteriorly with the cloaca.

Professor Haddon cites Hensen, Spee, and Flemming as having observed the origin of the segmental ducts from the epiblast in the rabbit and guinea-pig. Later (1886), Dr. Van Wijhe found the same to be the case in *Raia clavata*, and afterwards Dr. Perényi observed the same mode of development to obtain in *Rana esculenta* and *Lacerta viridis*.[3]

"The origin of the segmental duct from the epiblast being now known to occur in Elasmobranchs, Anura, and Rodents, we are justified in assuming that this is a general and probably primitive mode of formation. With the above-mentioned exceptions, all embryologists who have recorded observations on the development of the duct agree in stating that it is at first placed immediately below the epiblast, and that it gradually sinks within the mesoblast until it comes to lie close to the peritoneal epithelium; they also all agree in deriving the duct from the somatic mesoblast.

"The duct arises, in the Rodents, as a linear proliferation of the epiblast, in the region opposite to the intermediate cell-mass ('*Grenzstrang*' of Hensen). Flemming points out that the area is of variable length, not even being symmetrical. The separation of this solid cord of cells from the epiblast takes place from before backwards, and first occurs at a time when the mesoblastic somites are still entirely continuous with the ventral (somatic and splanchnic) mesoblast. Hensen, Spee, and Flemming conjectured that the primitive kidney is itself developed from the epiblast in these mammals; but of this they produce

[1] Edited by Prof. JOHN A. RYDER, Biological Department, University of Pennsylvania, Philadelphia.

[2] The Scientific Proceedings of the Royal Dublin Society, v., pt. vi., 1887, pp. 463–472, pl. x.

[3] [The editor would here, for the first time, record the fact that he has found the anterior ends of the segmental ducts intimately connected with the epiblast in young embryos of the catfish (*Amiurus albidus*), so that the mode of origin of the segmental duct spoken of above very probably applies also to the Teleostei.]

no direct evidence. It is more probable that the nephridia are of mesoblastic origin, as in other vertebrates.

"Van Wijhe finds that in the ray the pronephros (*Vorneire*) arises at the commencement of Balfour's stage I., as a continuous evagination from the somatopleure on each side of the body throughout five somites. When the hinder end of this evagination reaches the skin it fuses therewith, and the place of fusion is the rudiment of the duct of the pronephros (segmental duct). This grows posteriorly, gradually separating from the skin, so that its latest-formed end is always fused with it. The mesonephros (*Urniere*) is developed shortly after the appearance of the pronephros.

"In the frog Perényi finds that the duct develops as a canal-like separation from the inner (nervous) cell-layer of the epiblast, which later associates itself with the mesoderm cells of the intermediate cell-mass (*Grenzstrang*).

"According to the usually-received account, formation of the segmental duct may take place in two ways,—(1) either by the closing in of a continuous groove of the somatic peritoneal epithelium (Cyclostomi, anterior end only; Lepidosteus, Teleostei, Amphibia); or as a solid knob or rod of cells derived from the somatic mesoblast, which grows backwards between the epiblast and the mesoblast (Cyclostomi, posterior portion; Elasmobranchii, Amniota)."

At this point Professor Haddon further cites the literature, giving especial prominence to the views of Balfour on this difficult problem as discussed in his "Comparative Embryology," vol. ii. He then refers at length to the view propounded by Sedgwick in his well-known memoir, "On the Origin of Metameric Segmentation," and cites Lang, who says, "In certain Polyclades [Turbellaria] ramifications of the intestine open to the exterior by excretory pores, either on the dorsal surface (*Planaria aurantiaca* d. Ch.), or on the lateral edge (as in a very interesting new genus of the family of Proceridæ), thus forming a complete analogy with the excretory pores which are found at the edge of the bell in certain Medusæ.

"The aquiferous system characteristic of other Platy-elminthes does not occur in the Polyclades. The secretory organs of these animals are formed after the type of those of the Cœlenterata. Excretion in the two groups is performed by means of diverticula from the intestine which open to the exterior."

Van Wijhe's view is briefly summarized to the effect that the primitive Craniota had no pronephric duct, the pronephros opening outwards by a pore from the gland. Later, this orifice migrated backward and its outer border developed into the duct, and, approaching the cloaca, blended with and opened into it. He also thinks that the epiblastic origin of the segmental duct will not be welcome to those who think that the Chordata were descended from Annelids; but, for his part, he cannot admit the relationship between these types.

Professor Haddon then states his own view, as follows: "Without at all committing myself to a belief in the ancestry of the Chordata from Chætopod worms, I would offer the following considerations as tending to show that the vertebrate excretory system is readily comparable with that of Annelids, now that the epiblastic origin of the segmental duct has been established.

"It is perfectly well known that the nephridia of all invertebrates open directly to the exterior, and in the segmental worms there are typically a pair of nephridia for each somite.

"It is generally admitted that the early (not necessarily the *primitive*) Chordata were segmented, and it is not unreasonable to suppose that the nephridia were segmentally disposed, as there is usually a marked segmental arrangement of the nephric tubules in ontology. The peripheral orifices of the nephridia must either have opened directly to the exterior or from the first debouched into a longitudinal canal. Various theories have been framed to explain the latter arrangement, but the former condition is undoubtedly more easily conceived, one difficulty in this supposition being,—What has become of the primitive external openings?

"Accepting the proposition that in the primitive Chordata nephridia opened directly to the exterior, we have only to assume that the lateral area along which they opened was grooved, and that this groove extended posteriorly as far as the anus.

"From the analogy of the neural groove there is no great difficulty in further supposing that the nephric groove was converted into a canal, which, becoming separated from the overlying epiblast, might sink into the deeper-lying parts of the body.

"If a suggestion may be hazarded concerning the advantage of converting the nephric groove into the nephric duct, it may be pointed out that the lateral openings of the nephridia would not be far removed from the branchial clefts, and the need of pure water for respiratory purposes is emphasized by the now acknowledged fact that each cleft was provided with its own sense-organ (now metamorphosed into the 'thymus gland'). The development of the duct from before backward supports this view.

"From recent researches on the lamprey (Shipley), newt (Alice Johnson), Alytes (Gasser), and frog (Spencer), it has been proved that in these forms the blastopore never closes up, but persists as the anus (*i.e.*, the opening of the mesenteron into the cloaca).

"We are justified in assuming the persistence of the blastopore as the anus in early Chordata; thus, if the nephric groove were continued round to the anus it would practically open into the extreme hinder end of the mesenteron,—in other words, into the urodæum (Gadow).

"Probably about the same time that the nephric groove was being converted into the nephric canal (segmental duct) the proctodæum was being invaginated. The latter would push before it the posterior orifice of the nephric canal.

"The nephridia themselves appear to be of mesoblastic origin. It is possible that the *Archinephros* extended throughout the greater length of the body, as in Chætopod worms, but that in time an anterior section (pronephros) came to be developed earlier than the posterior portion (mesonephros).

"The precociousness in the development of the segmental duct in ontogeny is not necessarily a difficulty, as it can be paralleled by many other organs.

"On the hypothesis just sketched out the nephridia always open by their original epiblastic pores,—primitively, directly to the exterior; secondarily, into a canal separated from the epiblast: also the archinephros could be equally effectively functional throughout the whole period of its modification."

ANTHROPOLOGY.

Folk-Lore.—No other branch of anthropology is making more rapid progress than Folk-Lore, "or the popular explanation of observed facts and the customs arising therefrom." Sir R. C. Temple is the last to develop a scheme of the subject, on the spirit basis, as applicable to India. It is so comprehensive that it is given below in full, and may be easily adapted to any area:

SPIRIT BASIS OF BELIEF AND CUSTOM.

I. RELIGION.

A. Spirit-Worship.

Ancestor-worship.
Ancestors become guardians.
  Spirits as guardians.
  Badges or Devaks.
Spirits are mortals.
Spirits cause disease.
  Effects of this belief.
  Ornaments intended to scare spirits.

Articles which scare spirits:

Fire,	Ashes,	Breath,	Colors,
Water,	Beating,	Brooms,	Coral,
Metal,	Bells,	Canes,	Cross,
Urine,	Blood,	Circles,	Crown,
Arches,	Bread,	Clothes,	Dancing,

Dung,	Garlic,	Leather,	Salutation,
Earth,	Glass,	Lime,	Shells,
Eggs,	Grass,	Lifting,	Spirits,
Feasting,	Grain,	Noise and music,	Spittle,
Feathers,	Honey,	Oil,	Sulphur,
Flags,	Horns,	Ornaments,	Sugar,
Flowers,	Incense,	Precious stones,	Tattooing,
Fruit,	Indecency,	Ribbons,	Threads,
Food,	Kiss,	Salt,	Umbrellas.
Foam,			

B. Classes of Spirits.

Air-spirits:

Satkuvaris,
Vij, or Spirit of Lightning.

Epidemic-spirits.

Earth-spirits:

Vetal,	Bhairoba,	Jakhai,	Mukai,
Bramapurush,	Cheda,	Jokhia,	Navlai.

Water-spirits.
Underground-spirits.
Spirits generally.

Features, character, and mode of living spirits.

Spirit-haunts:

Funeral-places,	Groves, hills, heaths,
Boundaries,	House-roofs,
Roads and cross-roads,	Looking-glasses,
Stones, trees, caverns,	River-banks and sea-shores,
Deserts and waste-places,	Unclean places,
Empty houses,	Water- or pot-holes.

C. Spirit-Possession.

Into whom they enter.
Fear chief disposing cause.

Spirit-entries:

Head,	Mouth,	Yawning,	Feet,	Nose.
Hair,	Sneezing,	Hands,	Ears,	

Spirit-seasons:

Eating.
Times of meeting and bargain.
Auspicious events.
New-moon and full-moon days.

Effect of spirit-possession.	Black art.
How spirits are kept off.	Evil eye.
Exorcists.	Ceremonial impurity.

D. Stone-Worship.

E. Tree- and Plant-Worship.

Trees as old homes of men.
Sacred groves.

Food- or fruit-trees:

Cocoa-palm,	Pomegranate,	Plantain,
Mango,	Betel-palm,	Date.

Liquor-yielding trees,	Fire-yielding and evergreen trees,
Incense-yielding trees,	Plant-worship,
Healing trees and plants,	Grass-worship.

F. Animal-Worship.

Metempsychosis.

Home-haunters:

Ape,	Fly,	Dove,	Crow,	Mouse,
Ant,	Cock,	Rat,	Frog,	Serpent.

Tomb-haunters:

Bat, Owl.

Man-eaters:

Alligator,	Tiger,	Crocodile,	Lion,	Bear,	Vulture,
Dog,	Wolf,	Eagle,	Eel,	Hyena,	Tortoise.

Healers:

Ass,	Hare,	Deer,	Peacock,	Horse,
Cow,	Parrot,	Hog,	Swan,	Cat,
Goat,	Goose,	Fish,	Camel,	Kite,
Sheep,	Buffalo,	Jackal,	Elephant,	Spider.

G. Man-Worship.

Apotheosis:

Devarshis, or Bhagats,	Sons-in-law,
Guests,	Prostitutes and low women,
Husbands,	Dead kings and dead pious.
Kumaukas,	

H. Classes of Gods.

Primitive theology,	Local gods,	Planet-worship,
House-gods,	Fire-worship,	Water-worship,
House-goddesses,	Sun-worship,	Earth-worship,
Village-gods,	Moon-worship,	Mountain-worship.

I. Immortality of the Soul.

J. Sects.

K. Priestly Classes.

Aged relations,
Castemen,
Headmen,
Women,
Potters,
Washermen,
Dancing-girls,
Early tribes or lower classes.

L. Offerings.

Origin of religious offerings.
Human sacrifices,
Animal sacrifices.

M. Object of Ritual is to Scare Spirits.

Spirits attack the object of worship.

Baptism,
Confirmation,
Matrimony,
Sick,
The dying,
Burial,
Consecration of new house,
Consecration of new image,
Nagbali.

N. Festivals.

Makarsankranti,
Ratha Saptami,
Mahashivrata,
Holi, or Hutashani,
Varshapratipada,
Ramanavami,
Gokulashtami,
Shravani,
Dasara,
Divali,
Balipratipada,
Bhaubija.

To prevent attacks of spirits.

II. CUSTOMS.

P. Birth-Customs.

Peril of childbirth varies with race.

Birth-rites:
Deshasth Brahmans,
Kolaba Kunbis,
Puna Ramoshis.

Fifth- or sixth-day birth-rites:
Bombay Yajurvedi Brahmans,
Khandesh Bhils.
The cleansing of the mother.
The purification of the child.
Naming.

Spirit-scarers used in birth-rites:

Fire,
Feasting,
Yellow,
Water,
Noise,
Red,
Liquor,
Urine,
Metal.

Couvade.

Q. Marriage.

Hindu marriage-rites.

Child-marriage:
High-class child-marriage,
Middle-class child-marriage,
Lower-class child-marriage.

Widow-marriage,
Polygamy,
Wife-stealing,
Polyandry.

Spirit-scarers used in Hindu marriage:

Fire,	Yellow,	Oil,	Eating together,	Noise,
Rice,	Knots,	Horse,	Cocoanuts,	Red,
Cock,	Sugar-cane,	Dancing,	Metal,	Circles,
Dung,	Water,	Black,	Shells,	Fruit,
Marriage with trees,		Cloth,	Liquor,	Grass,
Hoisting,	Earthen-pots,		Miscellaneous objects.	

R. Womanhood.

S. Pregnancy.

Bombay Yajurvedi Brahmans,
Thana Vadvals,
Thana Parsis.

T. Funeral.

Descriptive funeral-rites:
Death-day rites,
After-death ceremonies,
Special funeral-rites,
Commemorative rites.

Meaning and origin:
Belief that man has several spirits.
Early and Brahmanic rites.
Devices to keep Spirit from his former haunts.

Spirit-scarers in Hindu funeral:

Fire,	Colors,	Cow,	Horse,
Urine,	Flowers,	Sweet basil and nim,	
Grain,	Metal,	Oil,	Circle,
Sacred grass,	Water,	Noise,	Leather,

Feasting and cleansing the mourners.—*O. T. Mason.*

PSYCHOLOGY.

Evolution and Idealism.—Evolution must be regarded as having completely abolished Berkeleyan idealism. If the external or objective universe is only subjective, the evolution of that universe must have been a reflection of that of mind; but as minds have been, and are, in various stages, at any given period of the history of evolution, there must have been many universes at one and the same time. Consider for a moment the metaphysics of the barn-yard. The various domestic fowls, and the mammalia, cat, dog, pig, ox, horse, etc., must each be the author of a different objective environment, all differing from that of man. But the environment is believed by evolutionists to be a very important element in the development of mind. If, however, the environment is the product of mind, there has been no antecedent environment, as understood by evolutionists. These two absurdities must prevent any consistent biologist from being an idealist in the Berkeleyan sense. The services of evolution in explaining the so-called innate ideas have been shown by Spencer to be very great. Innate ideas are seen to be inherited ideas, or the function of inherited structure; but as evolution requires also acquired ideas, the field of controversy between the intuitional and experiential theories is narrowed to these. Evolution stands on the experiential ground; not but that there is some axiomatic truth which the developed human mind is able to grasp without more experience than that necessary to a statement of the proposition; but without evolution by experience, man would never have acquired the power necessary to do this. —*E. D. Cope.*

MICROSCOPY.[1]

O. Schultze's Method of preparing the Amphibian Egg.[2]—For hardening-fluids the following mixtures were found to give perfectly satisfactory preparations, when used in the manner described below:

1. *Chrom-osmio-acetic Acid.*

Chromic acid (1%)	25 parts.
Osmic " "	10 "
Water	60 "
Acetic acid (2%)	5 "

2. *Chrom-acetic Acid.*

Chromic acid (1%)	25 parts.
Acetic " (2 ")	5 "
Water	70 "

The eggs are left in one of these fluids twenty-four hours, then washed in distilled water, which should be often changed. The egg-envelopes are next removed by the aid of needles, and the eggs are then ready for surface-study.

For the purpose of sectioning the eggs are transferred from the water used in washing to 50% alcohol, then to 70%, 85%, and 95%, leaving them twenty-four hours in each grade. The last grade should be changed several times. The eggs are then clarified in turpentine one to two hours, and then placed in paraffine that melts at 50° C. for one-half to one hour.

[1] Edited by C. O. Whitman, Ph.D., Milwaukee, Wisconsin.
[2] O. Schultze, Zeitschr. f. wiss. Zool., xlv., H. 2, p. 185, April, 1887.

Schultze states that the success of the method depends on following precisely the directions given as to time. If the eggs remain longer, either in alcohol, turpentine, or paraffine, the results may be entirely unsatisfactory. If the conditions are strictly followed the eggs have the consistency of the paraffine, and cut excellently without crumbling in sections $\frac{1}{200}$ mm. thick.

For staining borax-carmine was used, directly after washing, twenty-four hours. The eggs were next placed in acid alcohol of seventy per cent. (five drops of the pure acid to 100 ccm. of the alcohol) to remove a part of the color.

The first hardening fluid does not penetrate well, and is not well adapted for fixing the central parts of the egg.

Baskets for the Suspension of Objects in Paraffine.—Mr. H. Garman recommends the use of wire baskets for suspending objects in paraffine. Such a basket is easily made by coiling

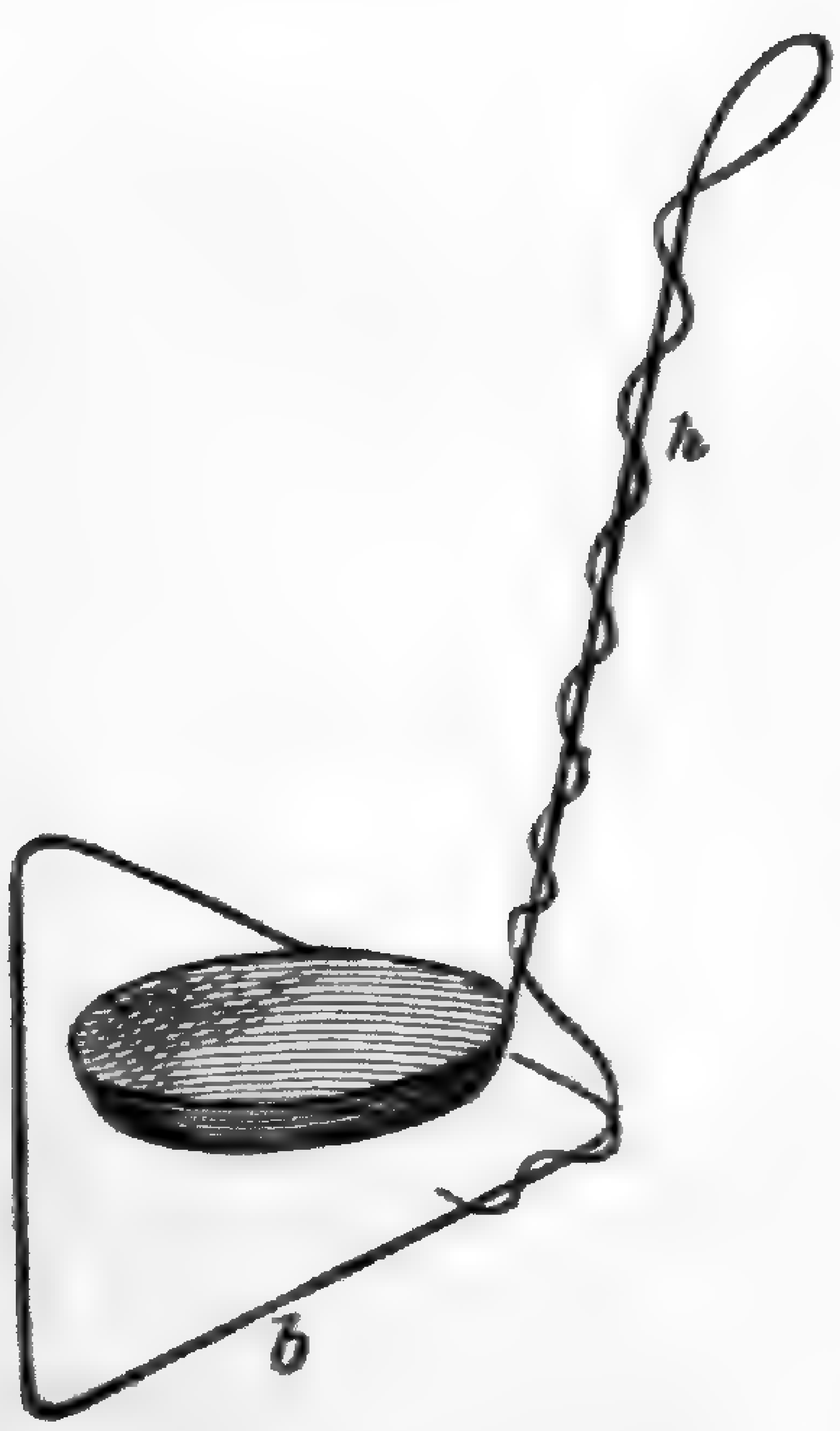


FIG. 1.

FIG. 2.

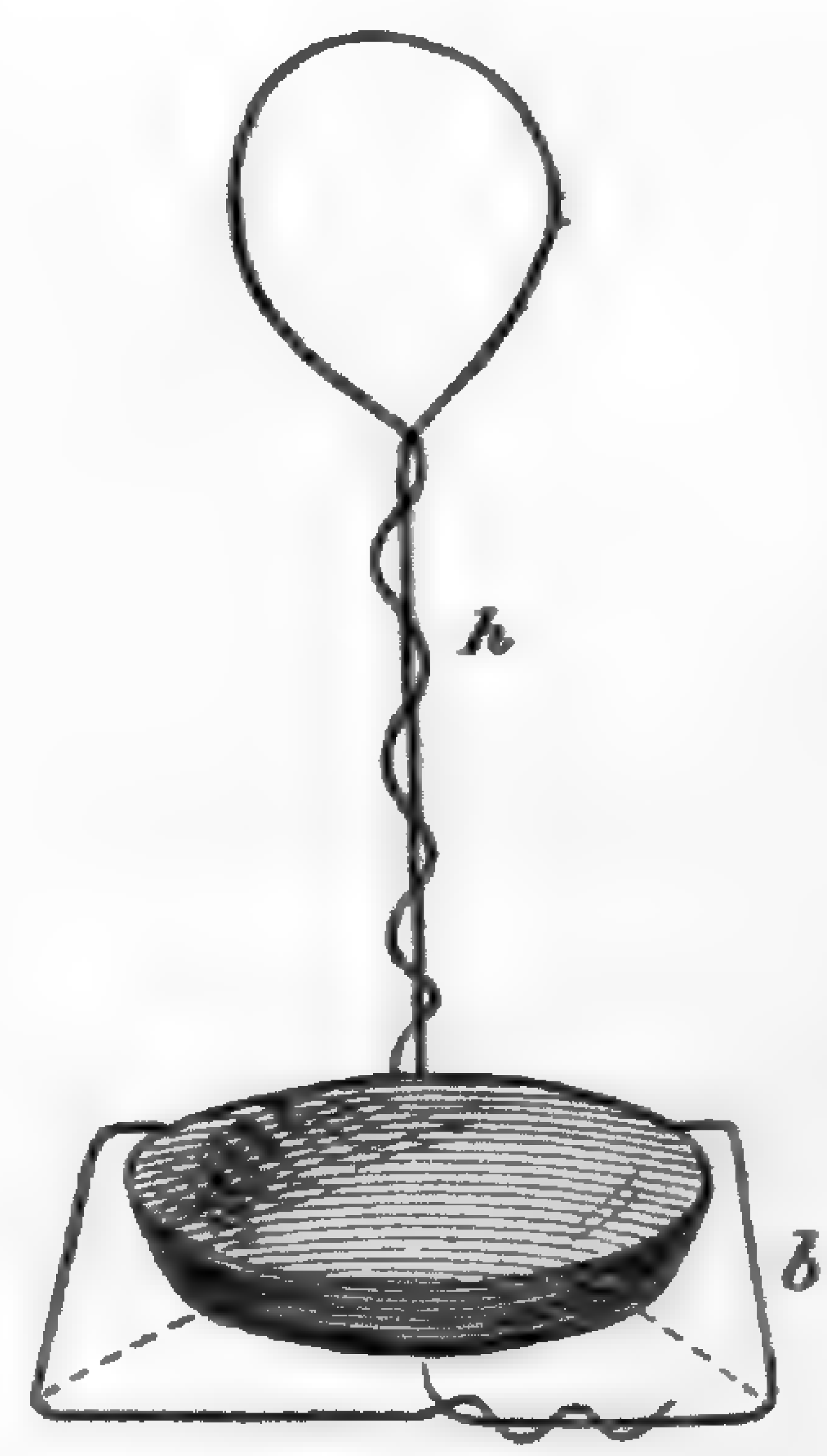


FIG. 3.

annealed wire as shown in Fig. 1, beginning at the centre of the bottom, and working outwards to the margin, then making the handle (*h*), and finishing with a triangular base (*b*). In use it is placed in the melted paraffine, the triangular base supporting and keeping it from the bottom of the paraffine basin; and it can be removed by means of the projecting handle, which is made of such length that it does not interfere with the glass cover of the basin. For very small objects a hammered-wire spoon, like that used by Dr. Mark, is mounted in the same way as the basket (Fig. 2). This method of suspending objects in paraffine has resulted from attempts to avoid long handles, or other belongings of the baskets, that prevent the close fitting of the plates of glass used to cover the paraffine dishes.

A New Section-Smoother.[1]—Dr. P. F. Mall recommends a section-smoother constructed on the following principle. It consists of a rubber rod, about 1 ¼ cm. in diameter, which rotates *loosely* on a solid axis. The rod is so placed that it hangs a little below and in front of the edge of the knife (Fig. 1). When the

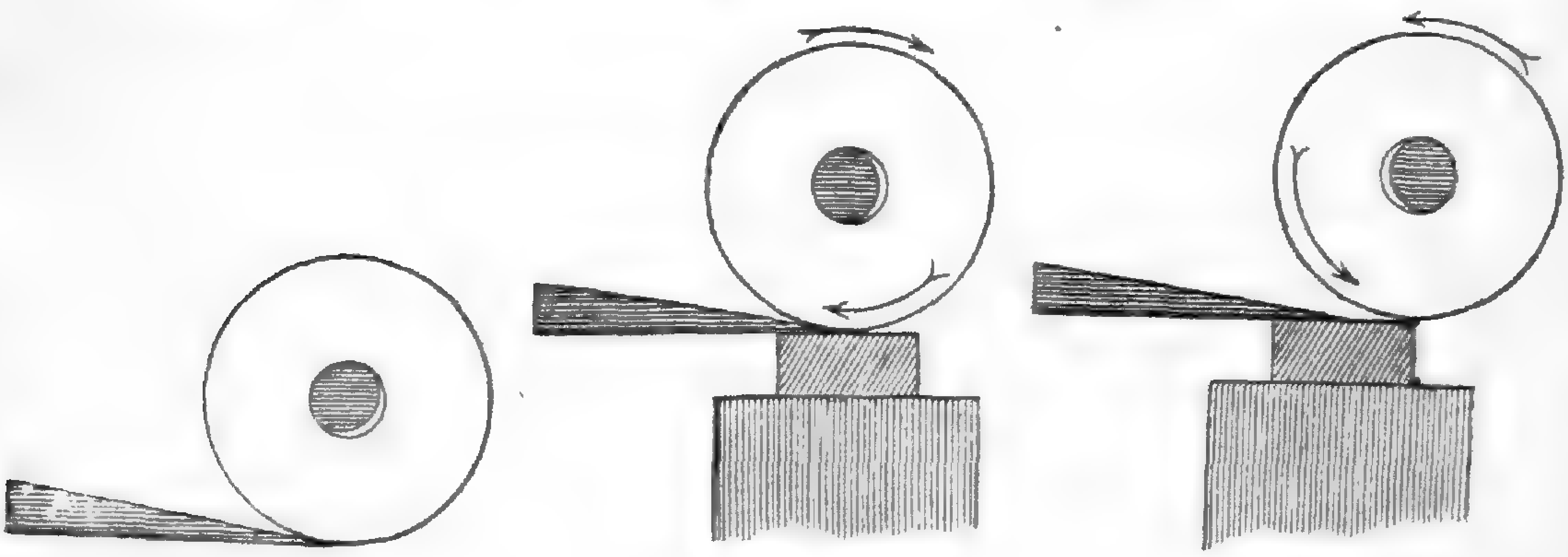


FIG. 1. FIG. 2. FIG. 3.

knife passes over the object the rod is raised to an extent equal to the thickness of the section, and is thrown above and a little behind the edge of the knife (Fig. 2), so that the section is prevented from rolling as it slides upon the knife. When the knife is shoved back preparatory to making the next section the rod rolls over the preparation, and, in consequence of the play of its axis, is kept free from edge of the knife. The section does not stick to the rod, as is the case in Jung's section-smoother.

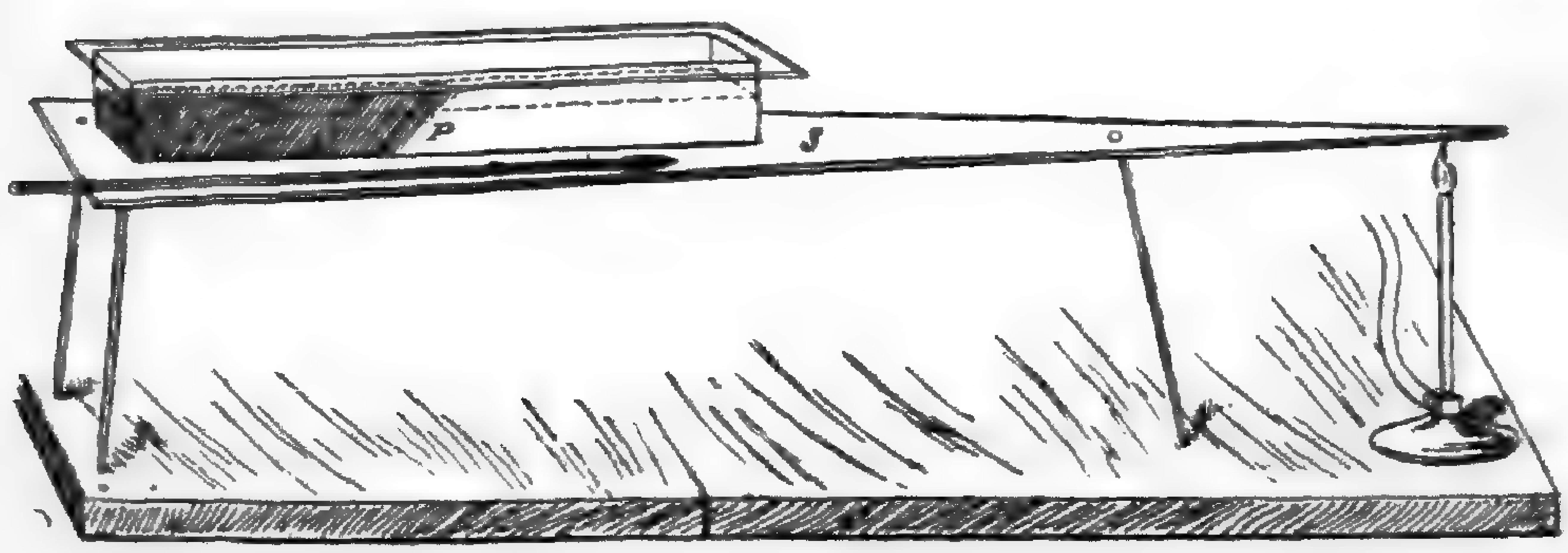
A New Paraffine Imbedding Apparatus.—Those who have had much experience in imbedding in paraffine are aware of the difficulties and risks which attend the imbedding of delicate objects on account of the danger of overheating the imbedding mass. The trouble with thermostats, or heat-regulators, is that they get out of order and give trouble, aside from the difficulty which arises from the variations in the pressure of the gas in the pipes which supply the burners, and which is entirely beyond the control of most forms of the thermostat.

To avoid this, Dr. C. S. Dolley, of the Biological Department of the University of Pennsylvania, began a series of experiments

[1] Archiv f. Anat. u. Physiol. Anat. Abth., 1887, H. 1, p. 3.

with copper bars, which were heated at one end by means of a Bunsen burner, so that the heat conveyed by conduction to the remote end of the bars gradually diminished in intensity because of its being constantly radiated into the surrounding air, according to well-known laws stated in the text-books on physics. It was found that, with the room at an approximately constant temperature, there was a point along the bar, at a certain constant distance from its heated end, where the temperature of 55° C. could be maintained, and where, if there was placed a copper cup filled with hard paraffine, the latter could be kept just at the point of fusion for a long time without endangering the objects to be imbedded. These results showed that it was possible to utilize an apparatus of this type for imbedding purposes.

This led the writer of this to begin a set of experiments with a very simple modification of the foregoing type of apparatus,



with the object of getting rid of the usual water-bath entirely in the process of imbedding, and to also use the paraffine itself as a means to indicate how far away from the source of heat it would be safe to allow an object to remain while it was being saturated.

This object was effected in the following manner: A triangular sheet of copper, slightly less than one-sixteenth of an inch thick, eighteen inches long, and ten inches wide at one end and running to a sharp point at the other, as shown at *s* in the accompanying figure, is supported horizontally upon two legs at the wide end, and at some distance from the pointed end by another leg, these three legs constituting a firm tripod base for the whole device. Under the pointed end of the triangular plate of copper is placed a small Bunsen gas-burner, with an aperture of about one-eighth of an inch, and connected with the gas-supply of the building by means of a rubber tube. If the flame is allowed to burn steadily at about half its full force, and permitted to play upon the copper plate at a distance of about one inch from its extreme point, as shown in the figure, the whole plate will soon be heated, but the temperature will be found to gradually diminish towards the wide end. At a distance of about twelve to thirteen inches from the point where the flame acts upon the copper plate the temperature will remain steadily at about 56° C. (133° F.), with the temperature of the room at 22° C., or 71° F. As long as the temperature of the room remains nearly the same the temperature of the plate at any given distance from the burner will also remain at the same point. This constancy is due to the fact that the heat which is conducted through the copper plate with constant rapidity from its source—the burner—is radiated into the surrounding air at an equally constant rate, and, as one passes towards the wide end of the plate from the burner, trials with the thermometer show that there may be found an infinite number of points in succession at which the temperature is very nearly constant.

In order to use the paraffine itself as an indicator of the proper temperature, and in that way dispense with a thermometer altogether, if desirable, it was necessary to use a new type of cup in which to melt the paraffine. The paraffine-cup or trough (P) shown in the figure is made of copper, tin-lined, and is six inches long, one and one-half inches wide, and one and one-fourth deep. In practice the cup is half filled with paraffine and placed lengthwise on the copper plate, with its narrowest side towards the flame and about nine inches from it, as shown in the cut. The paraffine-cup may be covered with a strip of glass to exclude dust. If the burner plays upon the plate as directed, and the trough is in the proper position, in about an hour it will be found that the paraffine in the trough has been melted at the end nearest the burner, but has remained congealed at the other. Moreover, it will be found that the point where the melted comes in contact with the nearly frozen paraffine is very constant, and it is just at this point where it is safe to place objects which are to be imbedded. The paraffine which remains congealed in the trough is represented in the cut by the shading at the remote end of the trough, the clear space below the dotted lines nearest the flame indicating the portion which remains molten.

It is clear, from what has preceded, that a shorter cup or trough filled with soft paraffine melting at 36° C. may be placed still farther away from the burner, alongside of the vessel containing hard paraffine fusing at 56° C., while mixtures of turpentine and paraffine or chloroform and paraffine would remain molten at a still greater distance from the flame.

The applications and possibilities of this new device will be readily appreciated by histologists and embryologists, since it can be quickly seen if objects are in danger from overheating by simply noting whether the point where the paraffine remains molten in the trough has advanced farther from the flame. This can be easily observed through the transparent cover of the trough.

For large laboratories, where a number of students are engaged in imbedding, a simple modification of this device suggests itself. For such a purpose a horizontal disk of sheet-copper, of the same thickness, but three feet in diameter, would afford room for a large number of paraffine imbedding-troughs, which could be arranged in a circle around and some distance from the centre, at which point a larger burner would be applied underneath. The temperature in such a device would diminish from the centre towards the periphery of the disk. The troughs would be placed upon different radii upon the surface of the disk, just as two or three troughs may be placed upon different radii of the triangular plate, which is practically the sector of a disk, as described above.

For imbedding delicate objects, small cups made of tin-foil, pressed into shape in circular, tapering moulds, may be satisfactorily employed with this apparatus, in the same way as the troughs.

The device described above can be made by any coppersmith for about two dollars.—*John A. Ryder.*

SCIENTIFIC NEWS.

—The Harvard Natural History Society this year celebrates the fiftieth anniversary of its foundation by a course of popular lectures on the Fauna of Massachusetts. The series embraces Birds, by Wm. Brewster; Reptiles, by Samuel Garman; Fishes, by Mr. Collins; Butterflies, by S. H. Scudder; Beetles, by Geo. Dimmock; Crustacea, by J. S. Kingsley; Spiders, by J. H. Emerton; Worms, by C. S. Minot; Cœlenterates, by S. F. Clarke; Sponges, by A. Hyatt; and others which have not yet been fully arranged for. The Harvard Natural History Society is second in age of college societies, and has embraced many of the prominent naturalists among its members. In times past it had collections and a library, but the specimens were long ago turned over to the Museum of Comparative Zoology, while the library of late years has grown but little, the University furnishing abundant facilities in this direction.

—Bernard Persh, late hospital steward at the Frankford Arsenal, near Philadelphia, died recently of typhoid pneumonia, at the age of thirty-seven. He was an enthusiastic microscopist, and had lately been conducting considerable investigations in bacteriology, and was very successful in photographing these organisms. Personally, he was a pleasant companion.

—Toeplitz and Deuticke, of Leipzig, announce a new journal, the *Centralblatt für Physiologie.* It is edited by Dr. Sigmund Exner, of Vienna, and Dr. Johannes Gad, of Berlin, and is issued under the auspices of the Physiological Society of Berlin. The first number appeared April 2, and the subsequent numbers will follow every two weeks. The subscription price is sixteen marks a year.

—Dr. W. Spengel, who has recently occupied the position of Director in the Bremen Museum, goes to the University of Giessen as Professor of Zoology.

—Professor C. Klein, of Göttingen, goes to the University of Berlin as successor to the late Professor Websky, whose death was announced in our March number. The chair of Mineralogy thus left vacant at Göttingen is filled by Dr. T. H. Liebsch, formerly of Königsberg.

—Professor A. Ludwig, of Giessen, has been called to Bonn to fill the chair left vacant by the retirement of the venerable Professor Dr. Franz Leydig.

—The well-known house of R. Friedländer und Sohn (Berlin) have begun the publication of another bibliographical periodical, *Bericht über die Verlagsthätigkeit von R. Friedländer und Sohn,* which is intended as a quarterly list of the publications of this house in the line of science.

—Dr. R. W. Schufeldt calls attention in the *Auk* for April to the valuable assistance that can be derived from the photographic camera in field ornithology.

—Dr. Pelletan's *Journal de Micrographie* begins this year the publication of a series of portraits of French scientific worthies. The faces of J. Béclard and Mathias Duval have so far appeared, but they hardly answer the announcement of portraits "magnifiquement gravés ou photogravés . . . formeront autant d'œuvres d'art." They are rather poorer than the series of "Leaders of Science" published by the English *Science Monthly.*

—At a recent meeting of the Marine Biological Laboratory (which, as noted in the April number of the NATURALIST, is to be the successor of the Annisquam Laboratory) it was voted inexpedient to attempt to open the station this year. It was also voted to grant Mr. Van Vleck the use of the apparatus, etc., now at Annisquam for the present summer.

—John T. Ogden, for many years a well-known dealer in microscopical goods in Boston, died in that city May 3, 1887. He was born in Woodbury, N. J., June, 1811, and in early life was a civil engineer.

—The various scientific and educational institutions in and near New York City have appointed a local committee of arrangements for the coming meeting of the American Association for the Advancement of Science, with the following officers: President, Dr. F. A. P. Barnard, President of Columbia College; Vice-Presidents, Chauncey M. Depew, Mayor Abraham J. Hewett, Morris K. Jessup, Dr. Henry L. McCracken, George William Curtis; Local Secretary, Professor Henry Leroy Fairchild. Miss Winifred Egerton is the president of the ladies' section of the local committee.

—Recent deaths: Dr. Franz Herbich, a geologist and custodian of the Klausenberg Museum, died January 15; J. J. Kickx, Professor of Botany at Ghent, died March 27.

—Dr. Albert Kellogg, the well-known botanist of California, died in Alameda, in that State, on the 31st of March, at the age of seventy-four. He was born in New Hartford, Conn., and went to California in the early years of the great migration to the Pacific coast. He soon abandoned his professional work and devoted himself to the investigation of the botany of California, with which he has been identified for over thirty years. He was one of the founders of the California Academy of Sciences, and in the Proceedings and Bulletins of the Academy the results of his researches have appeared from time to time. He visited Alaska in 1867 as surgeon and botanist of the special expedition of that year, Prof. George Davidson being the scientific director. Dr. Kellogg's name fills a prominent place in all of the leading works relating to West North American Botany. He was a man of singular genuineness and simplicity of character, as guileless as a child, and abounding in kindly spirit and good-will towards all.—*R. E. C. S.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—April 20, 1887.—Dr. J. Amory Jeffries read a note in which he took exceptions to certain statements made by Dr. E. G. Gardiner in his paper (*Archiv für microscopische Anatomie*, 1884) relative to the development of the epitrichium in birds. Mr. Edwin O. Jordan, in a paper entitled "'Vitality' of Minerals, Plants, and Animals," called attention to the recent address of President Judd of the Geological Society as reported in *Nature*, and pointed out the speciousness of the arguments advanced to show that the lines drawn between the organic and the inorganic departments of nature are false, and showed the absurdity of the claim that plants have more "vitality" than animals, and minerals more "vitality" than plants.

May 4, 1887.—Annual meeting.—The annual reports of the secretary, treasurer, and curator, were read and approved, after which came the election of officers for the ensuing year, with the following result: President, F. W. Putnam; Vice-Presidents, John Cummings, Geo. L. Goodale; Curator, Alpheus Hyatt; Honorary Secretary, S. L. Abbot; Secretary and Librarian, Edward Burgess; Treasurer, Charles W. Scudder, and a board of twenty Councillors. The retiring president, Mr. S. H. Scudder, then gave an interesting paper of his investigations of the distribution of the cabbage butterfly (*Pieris rapæ*) over America. Awhile ago he sent out several hundred circulars to selected persons, and points requesting all available data regarding this pest, and the paper read was the outcome. Mr. Scudder found nothing earlier than the historic introduction near Quebec, but was of the opinion that there was some evidence of its later introduction at other points. A feature in the dissemination of the species was its more rapid advance along the line of railways.

Natural Science Association of Staten Island.—New Brighton, April 9, 1887.—Steps were taken to form a local committee to represent the association in all matters that may arise from the meeting of the American Association in New York City next August. Dr. N. L. Britton made remarks upon the fungi collected by the members of the association during the past two years, most of which had been named by Mr. J. B. Ellis. Ten printed lists of the fossils found in the drift of Staten Island, by L. P. Gratacap, were distributed.

Indiana Academy of Science.—This society held its second field-meeting near Waveland, Montgomery County, Ind., May 19 and 20. Over thirty members were present.

Thursday, 19th, the day was spent exploring the wild and rugged region along Sugar Creek, known as "Shades of Death." In the evening Prof. T. C. Mendenhall, of Rose Polytechnic Institute, Terre Haute, delivered an address on "Weather Prediction."

Friday was devoted to an exploration of the valley of Clifty Creek and Pine Hills. The evening session was occupied in discussing the natural history of the region visited, and some of the results are of value to science.

The next meeting will be held, the last week in December, at Indianapolis.

Biological Society of Washington.—April 16, 1887.—The following communications were read: W. H. Dall, "Notes on a recent Exploring Trip in Florida;" H. G. Beyer, U.S.N., "On the Action of Caffeine upon the Kidneys;" C. H. Merriam, "Ravages of the Bobolink in the Rice-Fields of the South."

April 30.—The following communications were read: J. H. Kidder (1), "Specimen of Concoction found in a Cod-Fish;" (2), "Grass Balls from Pyramid Lake;" G. Brown Goode, "Notes on the Color of Fishes;" F. A. Lucas, "On the Os prominens in Birds;" W. T. Hornaday, "Civilization as an Exterminator of Savage Races;" William H. Dall, "A Genus of Mollusks new to North America."

May 14.—The following communications were read: Marshall McDonald, "The Causes of Certain Failures in the Culture of the Salmonidæ;" C. V. Riley, "Notes on Southern California;" P. L. Jouy, "A Bird new to Japan,—*Pitta oreas* Swinhoe, from the Island of Tsushima;" F. H. Knowlton, "The Recent Shower of Pollen in Washington,—the so-called 'Sulphur-Shower;'" W. B. Barrows, Engineer G. W. Baird, U.S.N., and others, "Does the Flying-Fish Fly?"

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NATURE OF THE IMITATIONS, ETC.

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One party used glue as a cheapening adulterant for the production of scale pepsin; another party has now succeeded in flooding the market with their imitations of my scale pepsin, owing to its extreme cheapness. This party now declares (not to the profession) that they use sixty pounds of dry egg albumen, peptonized by two hundred hogs' stomachs. A third party wrap their imitations in an exact *fac-simile* of my circular, making full use of all my testimonials. The great injury these imitations cause my preparations can easily be understood.

The protection chiefly relied upon is through the profession's vigilance in discriminating between the genuine and the spurious article. When prescribing my pepsin, most physicians now underline my name thus, JENSEN'S Crystal Pepsin, and no misconception can excuse substitutions. The great reputation of this pepsin lies in that it is a peptone pepsin, *i.e.*, the texture of the stomachs in which the ferment is lodged is entirely dissolved, thereby obtaining all the pepsin. When thereto is added my recent improvement in precipitating from this solution all of the earthy and saline matter, leaving only the azotized constituent, containing all of the peptic principle, and, finally, is further concentrated by drying it upon glass plates until brittle scales are formed, the reason for its high digestive power can easily be understood. Why it surpasses also in keeping qualities all of the former pepsins is owing to its scaly and brittle texture, it being the only organic medicine in the materia medica produced for the market in scales.

It is also perfectly soluble upon the tongue, pleasant to the taste, and practically inodorous.

Although it commands a higher price than any other pepsin in the market, it is, nevertheless, the most prescribed. Its purity and solubility, combined with its great digestive power upon albuminoids, have inspired physicians of a suggestive mind to try it also as a solvent for diphtheritic membranes and coagulated blood in the bladder. The success also of these novel uses has already become generally known to the profession all over the world. Physicians writing for samples will receive prompt returns.

Dr. Hollman (*Nederl. Weekbl.*, 18, p. 272) reports the case of an old man, aged 80 years, suffering from retention of urine, in whom the introduction of a catheter failed to produce the desired result. It was found that the bladder contained coagulated albuminoid masses mixed with blood. A few hours after the injection of about 16 grains of Dr. Jensen's Pepsin dissolved in water, a large amount of a dark, viscid, fetid fluid readily escaped by the catheter.—*London Medical Record.*

Dr. Edwin Rosenthal, acting on the suggestion of Dr. L. Wolff, has used an acidulated concentrated solution of pepsin as an application to the membranes of diphtheritic patients, for which there seemed to be no other help than tracheotomy, and reports that it acted like a charm, dissolving the membranes, admitting a free aëration of the blood, and placing them soon on the road to convalescence. The solution he used was:

℞ Jensen's Pepsin, ʒj;
Acidi Hydrochloric., C. P., gtt. xx;
Aquæ q. s. ft., fl℥j.

M. S.—Apply copiously every hour with a throat-mop.—*From the Medical Bulletin.*

Formula for Wine of Pepsin:

℞ Carl Jensen's Pepsin, gr. 192;
Sherry or Port Wine, ℥viss;
Glycerin. puris., ℥iss;
Acid. Tartaric., gr. v.

Sig.—fʒj after meals. This is three grains of the pepsin in each teaspoonful.

For severe attacks of colic it has afforded present relief, after a few doses have been given in short intervals, when other remedies have failed.

CARL L. JENSEN,

HOME OFFICE, 2039 GREEN STREET,

PHILADELPHIA.

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It is also perfectly soluble upon the tongue, pleasant to the taste, and practically inodorous.

Although it commands a higher price than any other pepsin in the market, it is, nevertheless, the most prescribed. Its purity and solubility, combined with its great digestive power upon albuminoids, have inspired physicians of a suggestive mind to try it also as a solvent for diphtheritic membranes and coagulated blood in the bladder. The success also of these novel uses has already become generally known to the profession all over the world. Physicians writing for samples will receive prompt returns.

Dr. Hollman (*Nederl. Weekbl.*, 18, p. 272) reports the case of an old man, aged 80 years, suffering from retention of urine, in whom the introduction of a catheter failed to produce the desired result. It was found that the bladder contained coagulated albuminoid masses mixed with blood. A few hours after the injection of about 16 grains of Dr. Jensen's Pepsin dissolved in water, a large amount of a dark, viscid, fetid fluid readily escaped by the catheter.—*London Medical Record.*

Dr. Edwin Rosenthal, acting on the suggestion of Dr. L. Wolff, has used an acidulated concentrated solution of pepsin as an application to the membranes of diphtheritic patients, for which there seemed to be no other help than tracheotomy, and reports that it acted like a charm, dissolving the membranes, admitting a free aëration of the blood, and placing them soon on the road to convalescence. The solution he used was:

℞ Jensen's Pepsin, ʒj;
Acidi Hydrochloric., C. P., gtt. xx;
Aquæ q. s. ft., fl℥j.

M. S.—Apply copiously every hour with a throat-mop.—*From the Medical Bulletin.*

Formula for Wine of Pepsin:

℞ Carl Jensen's Pepsin, gr. 192;
Sherry or Port Wine, ℥viss;
Glycerin. puris., ℥iss;
Acid. Tartaric., gr. v.

Sig.—fʒj after meals. This is three grains of the pepsin in each teaspoonful.

For severe attacks of colic it has afforded present relief, after a few doses have been given in short intervals, when other remedies have failed.

CARL L. JENSEN,

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PHILADELPHIA.

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