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AMERICAN INSECT GALLS.

By E. P. Felt, Albany, N.Y.

American gall insects constitute an exceedingly interesting assemblage, representing at least five of the larger and better known orders. It is worthy of note that by far the greater majority of plant galls are produced by members of the dipterous family, Itonididæ, and the hymenopterous family, Cynipidæ. Of approximately one thousand insect galls listed, members of the above mentioned groups are responsible for over 90% (nearly 95%), with two pecies of the delicate gall midges producing deformations to every one of the relatively better known gall wasps. The plant lice or aphids come next in the number of species, though they would be outranked if the gall mites, the Eriophyidæ, were included in this discussion. The other gall-making Diptera, Hymenoptera, and the Hemiptera and the gall-making Coleoptera and Lepidoptera are, numerically speaking, of comparatively little importance.

The numerous gall midges show a diversity of taste not evidenced among the gall wasps. The more than 600 galls produced by the midges occur on plants belonging to 69 botanical families and 202 genera. There is no such specialization, as we shall see later, in the Cynipidæ. The larvae of 60 species of midges live at the expense of the Salicaceæ; 48 of these are found on *Salix*; 28 occur upon the Juglandaceæ, all but one infesting *Carya*; 37 attack the Fagaceæ (31 of these being upon *Quercus*); 52 species produce galls on the Rosaceæ, 23 on the Leguminoseæ, 18 upon the Vitaceæ, and 125 on the Compositæ. The most obvious concentration of species, aside from those mentioned above, is the 41 species reared from solidago and the 20 to be found upon aster. These figures are approximate, yet taken in connection with the great diversity in the structure of these small insects, indicate that this group has been able to maintain itself upon a great many different plants through a considerable physiological adaptability, and that the distinctness of the species has been established by relatively small modifications in structure.

The Cynipidæ or gall wasps present an entirely different condition so far as the relation to the flora is concerned. They attack plants referable to only six botanical families, and assignable to but eleven plant genera. There is, however, a most striking concentration in food habits, since a very large proportion of the more than 300 gall makers subsist at the expense of the Fagaceæ which, for this group, means the genus *Quercus*, the exact number in our list being 277, though this figure, like those above, is an approximation. Thirty species have been reared from the Rosaceæ, 21 (*Rhodites*) living at the expense of the genus *Rosa*. The other species referable to the Cynipidæ are scattered in their food habits, the most evident concentration, and this far from marked, being the 12 species reared from various Compositæ, the genera *Silphium* and *Lactuca* producing four and three, respectively. This marked limitation in food habits is accompanied, as might be expected, by a high degree of specialization in structure.

The Aphididæ or plant lice live on a great variety of plants, though the gall-making forms occur upon relatively few plant families and genera, the most evident concentration in food habits being in the genus *Phylloxera*, with its 29 species producing galls on *Carya*.

The nealy allied jumping plant lice or Psyllidæ present a similar condition in the genus *Pachypsylla* and its relation to the numerous types of gall occurring upon *Celtis*.

The occurrence of a number of galls produced by closely related insects upon food plants belonging to a genus or even species, indicates a physiological relationship, and some of these groups at least offer excellent opportunities for the investigator who would study the relation between the specific identity of gall makers and the galls they inhabit. It is undoubtedly true that marked diversity in gall structure usually indicates the work of different insects, though there is a possibility that variations in the structure of these deformities may be related to some extent at least, to the period when the infestation occurs; in other words, oviposition before the tissues have swoollen to any extent in the bud may result in a somewhat different deformation than if egg laying be delayed until the leaves are partly unrolled. There are a number of cases where apparently identical gall midges produce markedly different deformations in the same or closely allied plants, and we are inclined to believe that the time of infestation in relation to the development of the host may be an important factor as well as the part of the plant attacked.

There is still much to be learned about insect galls and their makers. Many new galls await description, and exact knowledge respecting the habits of gall makers is far from complete. Certain localities offer exceptional facilities for solving the unknown, and we would suggest to nature lovers that the local occurrence of numerous galls should be considered an invitation to enter a charming and delightful field of study.

THE BARN OWL NESTING IN SOUTHWESTERN ONTARIO.

BY W. E. SAUNDERS, LONDON, ONT.

The Barn Owl (*Aluco pratincola*) has been known in Ontario only as a casual visitor, and I may, therefore, be excused in stating that I regarded with incredulity a letter from Mr. W. C. Armstrong, of Chatham, written on June 29, which told me that there was a nest of the Barn Owl containing six birds near there. However, when I telephoned him he was very positive, and as a result I took the next train to Chatham, and in the afternoon drove out to Charing Cross, where the young birds were in the barn of Mr. H. C. Hunter. To my surprise there were really six young Barn Owls, almost full grown and apparently full fledged. They were in a little pigeon house under the ridge of the barn, and as may be supposed, the floor, about seven by five feet, was well covered with pellets. The pellets from these young birds were of a peculiar flattened oval shape, and were remarkably uniform in character. They contained a remarkably small proportion of bone, possibly indicating extraordinary digestive activity. All the identified bones were those of the common field mouse, and the fur appeared to belong entirely to the same species.

Immediately on our appearance on the ladder they began to hiss in a manner that was to me entirely novel and surprising. All six birds made the noise together, and it resembled that made by escaping steam. I supposed they stopped to take breath sometimes, but as they immediately began hissing again I failed to detect them in the act. They were crowded together in a corner of the little room, and when after a while they stopped hissing, it reminded one of the habits of the frogs which call so frequently and continually, and then on the advent of an intruder cease calling altogether. That is exactly what the owls did, and after several minutes of continual hissing the silence when they stopped could almost be felt.

When we offered them a stick they attacked it with their beak, and occasionally struck at it with a foot, but they had not yet reached the age when the uses of their feet were properly appreciated. After a while a ildness seized four of them and they rushed around the room, and one went out through a small hole and flew away. Where he went to is still a puzzle, but no doubt his parents found him at night.

The old ones do not appear in the day time, but come towards evening with food, and they have always been silent ever since they arrived in February, the hiss being the only sound Mr. Hunter has heard from them.

The only recent record of these birds for Ontario was when two were taken, one at Pelee Island and one at the base of Point Pelee in 1914, and there are a few other records of the occurrence of the bird, but this, I believe, is the first nesting that has ever been reported.

SOME NOTES ON FOSSIL COLLECTING, AND ON THE EDRIOASTEROIDEA.

By George H. Hudson.

Part II.

(Continued from page 25.)

Bather's "Studies in Edrioasteroidea," which appeared in the Geological Magazine at different times from 1898 to 1915 inclusive, have now been collected into one volume and published by the author at "Fabo," Marryat Road, Wimbledon, England. In this reprint the dates and paging of the Geological Magazine have been retained, and our references will, therefore, apply to both the original papers and the reprint. As examples of thorough study of what specimens have to reveal, these papers are unexcelled. It is highly probable, however, that the specimens themselves lack structures they once possessed, and that such structures will yet be found, either in more complete individuals or in fragments. Before specifying what I believe will be the nature of such finds, let me give some instances of structure rarely preserved.

Of what he calls the "tubular pyramid" on Pentremites, Hambach says ("Notes about the Structure and Classification of the Pentremites,"; Trans. St. Louis Acad. of Science, Vol. IV, No. 3, p. 6): "The only species on which Dr. Shumard observed the same, was a specimen of P. *sulcatus*, Roemer. . . .

It is so seldom found preserved, that in thirty years' collecting, during which time I collected at one locality more than 6,000 specimens, I found only two specimens having this cone-shaped body preserved." In his "Revision of the Blastoidea," (1903, p. 14), Hambach also calls attention to a structure "on the posterior side above the anal opening, on very well preserved specimens, a small proboscis about one-fourth of an inch in length, constructed of small hexagonal pieces, as shown in Figs. 6 and 7. To my knowledge it is the first time that such a body has been observed on a Blastoid. I found this appendix on *Pentremites conoideus*, and have now four specimens of it showing this, so far unknown, organ." When, however, Hambach finds the ambulacral area more or less roofed over with small cover-plates, he believes them to be "fragments of broken-up pinnulae," or "small ovulum-like bodies," . . . . "due to the oolithic character of the rock in which they are imbedded." In the latter case a true structure, rarely found, is apt to be cleaned away, because of a belief that it does not belong to the specimen. It is well here to emphasize the need of most careful scrutiny before any attempt to modify an exposed surface.

Of Blastoidocrinus it seems that the nearly perfect Valcour Island specimen is the only one ever found still retaining its large "apical plate," its prominent series of "wing plates," (which form above the cover plates and completely hide the latter from view), and its brachioles; yet *B. carchariaedens* is one of the common fossils of the Chazy limestone. Additionl examples might be given, but the above are sufficient to show that species may be abundant and the mass of collected material very great indeed, and yet valuable evidence be lacking as to morphology, function and relationship.

From certain resemblances between Blastoidocrinus and some genera of the Edrioasteroidea, and from an examination of the only mechanism apparently used by the latter for the function of food-capture, I am forced to conclude that certain genera now grouped by Bather in this order possessed brachioles, and that purposive search for these structures in additional material, and it may be very fragmental, will sooner or later reveal them. My belief is based on the following facts.

The Edrioasteroidea are closely allied to the Cystidea, and by many made an order of that class, as in the last edition of Zettel's Text-book of Paleontology (Eastman). Bather follows Billings in recognizing the marked characteristics of this group, but places it no higher than a class of the subphylum Pelmatoza, making it equal in rank to Cystidea, Blastoidea and Crinoidea. All these classes were feeders on minute or microscopic plant and animal forms of the plankton, or on equally small but perhaps more abundant forms living on the bottom. The collecting apparatus consisted of numerous small brachioles or pinnules which captured the living organisms by means of ciliated grooves, lined with viscous secretions, and protected by a series of minute alternating cover-plates. The material caught by brachioles or pinnules was passed into common covered ways leading to the mouth. The main streams became in time mere conduits, and the surplus water taken in with capture and used for conveyance was either gradually lost between the cover-plates or carried to specialized separating areas, where the water was sent to hydrospires and made to assist in respiration. With this manner of food getting it will readily be seen that the cover-plates nearest the mouth would tend to remain closed and to become permanently fixed, or the proximal portions of the food grooves might become subtegminal in position. In every case the extent of the collecting portion of the apparatus is proportioned to the needs of the organism, and to the abundance of minute organisms in its habitat. Deprive Crinoid, Blastoid, Parablastoid or Cystid of its pinnules or brachioles, and its larger or main covered food-grooves could no longer function. Now, we must ask ourselves these questions. If the Edrioasteroidea are Cystids they belong to a group that secured their food by means of brachioles; they were for the greater part fixed and sessile forms, and could therefore only feed on such passing organisms as they could capture; for their size they show no greater length of covered food-grooves than we find in Malocystites, which was an elentherozic form and a feeder close to the sea bottom. Why should the Edrioasteroidea have lost the inheritance of the collecting mechanism of their class, and how could they secure sufficient food without it? These are serious questions, and they are made no easier by raising the group to class rank, for even then every other class of their subphylum required and retained the fringing brachioles or pinnules.

If we compare Blastoidocrinus with Steganoblastus, the need for and probable possession of brachioles by the latter will become more evident. Both are stemmed forms, with similarly shaped body cavities, and with proportional surface areas, covered by large food-grooves. In Steganoblastus, a name suggested by Bather on account of the *closely covered* condition of the main food-grooves (1914, p. 193), we find "large covering plates," (loc. cit.) which form a prominent rounded arch over the groove" (1914, p. 200). "At the proximal end smaller plates may be intercalated along the middle line" (1914, p. 199, and fig. 5, p. 200), or "the medial suture in the proximal region becomes curved and interlocking" (1914,

p. 199), and "apparently immovable over the mouth region" (1915, p. 212). In Blastoidocrinus we have also a closely covered condition of the similarly placed main food-grooves. We have *large covering plates* which *arch over the groove*, and are rendered *immovable* over both *rays* and *mouth region* by a series of still heavier accessory plates, called by the author "apical or anal pieces" and "wing plates," though for the former the term supraoral would be perhaps more appropriate. These ossicles are figured in N.Y. State Museum Bulletin 107, plates 6 and 7. In Blastoidocrinus a specimen the size of Styanoblastus would have about 350 brachioles for a catching apparatus to supply its covered main food-grooves. Bearing now in mind the fact that both were stemmed Ordovician forms which lived in the Ottawa sea, we must appreciate the difficulties which arise if we deny brachioles to Steganoblastus. Why should a continued stemmed existence in a similar environment cause the loss of a specialized and efficient collecting apparatus, and leave only the five main ways to the mouth, and these still closely covered with covering-plates, immovable at least for the mouth region, and for the older portions of the rays.

There are other interesting points to be gathered from Bather's description in which *Steganoblastus* resembles *Blastoidocrinus*. "The very deep folding of the plates," (1914, p. 195), in adapical and interambulacral areas are in Blastoidocrinus due to plate growth or development over hydrospires. There is a "series of pores" between the outer ends of the floor-plates and "just below the attachment of the cover-plates" (1914, p. 198). "The pores between the floor-plates pass through into the thecal cavity" (1914, p. 199), entering hydrospires in both Blastoidea and Parablastoidea. "There is a cover-plate to each floor-plate, and so far as can be ascertained after prolonged preparation and study, the sutures between the cover-plates coincide with those between the floor-plates. Thus, the pores, which as already stated, lie just below the attachment of the cover-plates, open under the sutures as in *Edrioaster*" (1914, p. 199). Precisely this condition is to be seen in Blastoidocrinus (N.Y. Museum Bulletin 149, plate I, fig. 2).

Of the outer border of the food-grooves Bather says: "The suture between the cover-plates and the adambulacrals is flush, and the curve of the cover-plates passes over, though with a distinct bend, into that of the adambulacrals. The suture is not a straight line, but a series of curves, the convex outer edges of the cover-plates fitting into slight concavities in the adambulacral margin. The position and number of the axial ridges on this margin indicate that the original adambulacral elements coincided in number but alternated in position with the cover-plates, and therefore also with the floor-plates. This suture, then, is essentially a zigzag suture between two sets of alternating plates. In consequence of this arrangement one would expect to see along the edges of the groove, when the cover-plates are removed, a series of depressions or facets for the reception of the cover-plates. Unfortunately the edges have in nearly every case been worn enough to remove all trace of these very faint depressions . . . ." (1914, p. 200).

This rather lengthy quotation has been made to show that besides the cover-plates and floor-plates we have present in Steganoblastus a third series of morphological elements belonging to the food-groove. One must at once question if these are not likely to be homologous with the outer side-pieces of Blastoidea, and to function as do the latter in assisting in the support of brachioles.

We should note that the question as to how these five closely or immovably covered rays secured an adequate food supply is not the only question raised by a study of the form and surface of Steganoblastus. How did it perform the very essential function of respiration, is another and very serious question. We find ample provision in Blastoidocrinus and the Blastids in elaborate hydrospire systems. Steganoblastus must also have possessed such a system, and the presence of hydrospires is strongly suggested in Bather's figures 2 and 3 (1914, plate XV), where the floor-plates have been lost. A system of this kind however, presupposes the possession of brachioles.

In Edrioaster the branch channels which end in pores (Bather, 1914, p. 118) are bordered by double ridges, the innermost of which are regularly broken transversely. This structure, shown by Bather, 1914, plate XIV, fig. 3, while not so elaborate as that shown by Hambach in his "Revision of the Blastoidea," plate II, fig. 5, is yet suggestive of the latter, and is an indication of structure associated with the segregation of the more solid contents of the food stream from the water accompanying it. Bather seeks to derive the Asterozoa from the Edrioasteroidea (an exceedingly probable derivation), but in doing so injures his case by interpreting the pores of Edrioaster as podial openings—going so far as to sketch outlines of an ampulla and base of a podium, in 1900, p. 197, fig. 4. Primitive sea-stars possess no podial openings between the floor-plates. This fact is now emphasized by Spencer in his "Monograph of the British Paleozoic Asterozoa," part I, (1914).

Under the heading "Relations of Steganoblastus," Bather says: "The absence of brachioles, inferred from the lack of brachiole-facets and the presence of large cover-plates, proves that Steganoblastus is not a blastoid, not even one of the Protoblastoidea, as was at first supposed" (1914, p. 202). We must modify this statement. The presence of brachioles should be inferred from the presence of small bordering plates equal in number to the floor-plates, and in zigzag arrangement with them; from the manifest need for additional structures to assist in food capture and respiration; from the appearances noted suggesting hydrospires; and from the presence of cover-plates nearly as large and solidly fixed as in Blastoidocrinus, which does possess brachioles. The peculiar blastoid-like markings on the channels of the food-grove noted in Edrioaster may be added to this list, for they will probably be found in both Blastoidocrinus and Steganoblastus. Bather goes on to say: "Secondly, the structure of the subvective groove, with its floor-plates and cover-plates, and its pores between the floor-plates, is paralleled by Edrioasteroidea alone among Pelmatozoa, and in that class most closely by *Edrioaster*, though there are minor differences" (1914, p. 202). This statement cannot stand, for in the points enumerated *Steganoblastus* is paralleled by *Blastoidocrinus*, and both plates and pores no doubt functioned in a similar manner.

We have here a very definite problem to solve, and as we are more likely to find or notice that which first exists in the "mind's eye," a clear comprehension of the problem may lead to an early solution. This idea of a problem-phase in collecting is one we should carefully bear in mind.

Before closing the present paper a few remarks on "field notes" may not be out of place. It is sometimes desirable to know the position assumed by a form, either while living or during burial. With surface material the determination is easily made. In the case of the holotype of *Palaeocrinus striatus* Billings, we desired to know whether or not the flattening of the theca was normal. The varying degrees of weathering, and the cutting away of the under side to free it from its matrix showed that this specimen was buried with the flattened posterior side down. The bent in condition of that surface may then have been simply due to pressure after burial. (N.Y. State Museum Bulletin 149, p. 216-217). In the Valcour Island specimen of *Blastoidocrinus carchariaedens* Billings, a knowledge of the side down at death would assist in proving the respiratory function of the hydrospires and the condition of the growing inner edges of their folds, for fine muds were swept into these folds after the stem could no longer support the theca, and before death occurred. (N.Y. State Museum Bulletin 107, p. 114, and fig. 2 on p. 105). In Canadacystis emmonsi (Hudson), the rounded, protruding portion of the theca seems to have been an adaptation to secure stable equilibrium on the sea floor with arms and mouth uppermost. Most specimens of Malocystites when rolled on a table come to rest with the food-collecting field uppermost. That the theca in this species rested on the bottom is shown by the area over which arm extension did not take place, and in this portion of the theca the plates were the heavier, thus lowering the center of mass and securing stable equilibrium with this part down. Dr. Foerste (1914) believes that the slope of the bed or surface of attachment influences not only the form of the theca, in Agelacrinus, but also the bending of the rays; and Bather (1915, Geological Magazine, p. 261) says: "Here, as in so many similar cases, the field collector and observers have not supplied the laboratory worker with the desired evidence." Not only has gravity left many an unread story of its influence, but even orientation has some important new items for us; for instance, see Patten, 1912 (Evolution of the Vertebrates) p. 377-379, and fig. 257, where much of the "mode of life" of Bothriolepsis is determined from the position of the remains of this genus as preserved in the beds near Dalhousie, New Brunswick. Orientation may also have much to tell the paleogeographer as to direction of stream flow and of tidal currents. It would be a very easy matter to mark collected material in the field with an arrow in its under surface, indicating north. There seems to be room yet for improvement in our purpose in going afield, in our judgment of the character of the material saved, in our marking the specimens when found, and in the character of our field notes. We must also bear in mind that there is much to be saved and gained through any guiding care or assistance we may give to those lovers of nature who belong to the generations that are following ours.

NOTE.

Mr. J. H. Emerton, of Boston, Mass., spider specialist, recently visited Ottawa and other points for the purpose of collecting spiders. During his stay in Canada he obtained a large number of different species, the collection of some of which extended the known range of distribution. Mr. Emerton is making a special study of Canadian spiders. Members of the Club interested in entomology could assist materially in such study by sending specimens from their immediate districts. If preferable, the Editor of THE OTTAWA NATURALIST would be glad to forward any material sent to him.

A PRELIMINARY PAPER ON THE ORIGIN AND CLASSIFICATION OF INTRAFORMATIONAL CONGLOMERATES AND BRECCIAS.

BY RICHARD M. FIELD, AGASSIZ MUSEUM, CAMBRIDGE, MASS.

(Continued from page 36.)

The author shows that in ground plan these structures are quite similar to mud-cracks, and that they may be accounted for by the excessive dessication of limy sediments or clay-like material which has been preserved above water level for a sufficient period of time to permit of an abnormal deepening of the surface mud-cracks. Should the spaces or cracks between successive layers of such columnated limestones become impregnated with a subsequent deposition of limy, or even sandy material, an interesting type of intraformational breccia would probably be formed.

Hyde (6) describes a peculiar limestone conglomerate from the so-called "fresh-water" horizon of the Ohio coal measures. He writes: "after complete evaporation and cracking of the limy surface, it is necessary to suppose that there was a submergence in order to account for the matrix of small fragments and shells in which the pebbles all rest. * * * * If, after the conglomerate was completely formed, the deposition of limestone had been resumed instead of a soft shale, the result would have been a typical intraformational conglomerate of a thinner type, in which the structure would probably have been so obscured that a detailed study would have been impossible, or only possible with a great amount of labour."

BIOGLOMERATES.

There is some evidence that certain intraformational conglomerates may have been formed partly by organic agencies. Their origin may have been the result of either plant or animal (?) activities, and furthermore, the organisms may have had either a direct or indirect structural influence. Certain so-called "limestone conglomerates" are supposed to be composed of fossil organisms. Thus, Seeley (7) describes conglomerates from the Beekmantown of the Champlain valley as having their pebbles formed from sponges, a new genus, which he called *Wingia*. Brown (8) describes certain conglomerates at Bellefonte as due to the action of lime-secreting algae. He notes how important the algae are as reef-building organisms to-day, and remarks that Lithothamnion-structure is easily obliterated by percolating waters so as to form a structureless limestone. He concludes: "It is freely admitted that in these pebble-like structures from the Cambrian and Ordovician limestones, no organic structure has been found sufficiently well preserved to prove conclusively that they are of algal origin, but their similarity to such structures now forming is very suggestive." In discussing the orientation of the edgewise conglomerates, he follows Hahn's and Grabau's theory that the deformation and regrouping is largely due to "submarine slumping." The "Strephochetal conglomerates" mentioned by Seeley (9) are probably not true conglomerates. Seeley writes (op. cit. p. 152): "The spherical or elongated masses breaking down from a weathering rock appear like rolled fragments or calcareous concretions, and such without doubt they are in many cases. Yet a careful study of these will disclose the fact that a portion of these nodular forms have definite structure." Thus, the stratigrapher is apt to be led astray by certain fossiliferous rocks, which, upon a macroscopic and hasty examination, have all the earmarks of a true intraformational conglomerate, but which really owe their structure to a certain type of organism included in them. It is possible, however, that true intraformational conglomerates may be formed by the activities of organisms. The writer collected an interesting specimen from the lower Beekmantown at Bellefonte, which would seem to suggest another mode of origin, but somewhat along the lines suggested by Brown. The specimen shows a narrow band of unstratified and peculiarly shaped phenoclasts (see fig. 2). The phenoclasts themselves are only slightly fossiliferous and are fine-grained, showing no definite crystal structure, and have peculiar and varied outlines. The interstices are filled with a cement largely composed of algae and the debris of small shells, the former preponderating. The shape of the phenoclasts and the presence of the algae in the cement would seem to show that the fine-grained, uncrystallized muds deposited in intermittent layers upon the sea floor were broken while still in a plastic state by the action of the algae. The processes of primary deposition of the limy mud, floculation, and redisposition of the "conglomerate mass" were practically coterminous with the primary lithification of the limestone under discussion. Sardeson (10) in discussing the pseudo-brecciated structure of the Ordovician limestones of Manitoba, originally described by Wallace (11), makes the following statement: "In the bed number 3, lumps, cakes and lenses of pure, light-coloured, fine-grained limestone lie isolated in a brown, fucoidal shale, and the evidence is then clear that the lime was originally deposited in lumps or masses. The lime quite certainly came mainly from the decomposition of marine algae in the manner lately described by Thomas C. Brown. Without entering into a discussion of the questions as to what plants and animals may have contributed to the limy deposit, or in what manner the lime was collected, it is sufficiently evident to me that something deposited lime in small and large masses. The lenses and lumpy patches of relatively pure lime in all parts of the Galena-Trenton frequently inclose fossil shells, etc., in a way to show that these limy bodies *were soft when deposited*; that is to say, they often partly inclose shells, stipes of graptolites, fucoids, etc., either in the manner of objects overflowed by soft lime or in the manner of objects partly sunken into such a soft deposit. Shells of Lingulae are found which had bored into them—and the boring, was done, of course, while they were not consolidated." Sardeson himself advances a rather ingenious hypothesis for the formation of "corrosion conglomerates" (op. cit. p. 276). He believes that the "fucoids" found in the shaly limestones associated with the conglomerates are the roots of a sea-weed, closely related to *Camarocladia*, and that because of the hardness of the sea-floor these roots are supposed to have been able to penetrate vertically but a short distance, and thus could be easily uprooted by the rafting of flotsam at the surface of the water. He concludes: "Since the conglomerates are found in limited horizons instead of throughout the beds or formations, their origin is to be attributed rather to catastrophies, such as rafts of sea-weeds, etc., * * * *." Here again we may have a true intraformational conglomerate formed by vegetable means.

GLEITUNGSPHEOMENE.

Sub-aquatic and sub-aerial-gliding-deformation or solifluction. Under the heading "Sub-aquatic, gliding deformation," Grabau (op. cit. p. 780) writes: "Offshore deposits of sediments on a gently sloping sea or lake bottom may suffer, from time to time, deformation of the surface layers through gliding or slipping down the gently-inclined sea floor. * * * The most remarkable fact about the gliding in Zug was that it took place on an average grade of 6% (3°26′), while the larger and more pronounced movement occurred on a grade as low as 4.4% (2°31′)). The material thus slid into the lake was *brecciated* (italics are the author's) and folded with overfolds, overthrusts, reversals of layers, excessive strata, etc., and furnishes an excellent guide to the interpretation of similar movement in the past." Under the heading "Examples of fossil subaqueous solifluction," (op. cit. p. 781), the author quotes numerous examples from the Cambrian to the Miocene, bringing out the interesting fact that the intraformational structures are to be found at all stages of the earth's history. He does not distinguish, however, between kinds of sediments in which these folds and *breccias* are developed, and whether or not they were formed under fresh or salt water. It is interesting to note that Hahn builds his hypothesis upon the observation of the movements and deformations of lake deposits and clays. Grabau, likewise, cites examples of deformation in the Miocenic marls of Oeningen. He shows two photographs of this clay folded in this way, in neither of which has the writer been able to observe any signs of true brecciation, or such brecciation as was supposed to have taken place in the formation of the edgewise conglomerates at Bellefonte, Gaspé peninsula, and Trenton Chasm. In short, the tightly closed and delicately delineated folds, so beautifully illustrative, are very typical of the subaqueous solifluction of clays. Whether or not this peculiar type of folding is to be found in limestones is open to question. The writer has observed such folds in clays and delta deposits, but he has not seen any signs of true brecciation. It is possible that many of the Pleistocene, and even older occurrences, may be of glacial origin. They appear to be rather typical of clay deposits and glacial rock flours. In the case of the Devonian examples of intraformational breccias from the Cape Bon Ami limestones of the Gaspé region, we have a contorted and brecciated bed made up of alternating layers of shale and limestone, which, as described, is similar to those found at Trenton Chasm. It seems a somewhat strange coincidence that while subaquatic solifluction is postulated as having taken place, in most instances, in a more or less homogenous type of deposit, that in such localities as Gaspé, Trenton Chasm and elsewhere it should be confined to that portion of the strata in which there is a variation in the constitution of the sediments deposited. Although the writer fully realizes that the above cited facts may not be fatal to any hypothesis regarding submarine-gliding-deformation, yet, as the evidence in these cases tends very strongly to prove an alternative hypothesis, it must be scrutinized with some care. Although some "edgewise conglomerates" may be due to submarine slumping, it is difficult to conceive that the majority of intraformational breccias are the result of this process. Certain of the intraformational glomerates are of wide geographic extent, and of great stratigraphic regularity, although of great thinness. It is perhaps easier to conceive of a more or less horizontal, mudcracked flat or tidal estuary than it is to conceive of a submarine slope, along which "slumping" had taken place regularly and evenly over a similar distance. Although it has heretofore been stated otherwise, the textures of the phenoclasts, in most of the stratified and unstratified glomerates examined by the writer, have been found to be slightly different from the matrix. This tends to show that the sediments forming the phenoclasts and the cement were not derived from the same horizon. It is only reasonable to suppose that this lack of homogenity between the phenoclasts and their cement is intimately connected with their history. The writer believes that subaquatic-gliding -deformation is undoubtedly a good theory to account for the production of intraformational phenomena, but that its application in the case of the intraformational limestone glomerates is, according to the present data, extremely limited.

UNSTRATIFIED AND EDGEWISE CONGLOMERATES.

Of all intraformational glomerates, probably the so-called edgewise variety is the most notable in the field. Edgewise glomerates are apt to have their structure well developed by differential weathering, and the striking arrangement of the phenoclasts has caused several students of the sedimentary rocks to offer an explanation as to their origin. Probably the two leading hypotheses regarding the origin of these special glomerates are those of Hahn, and Walcott, previously mentioned. The writer believes that certain edgewise conglomerates which he has seen owe the explanation of their origin to Walcott's theory, although it is possible that edgewise breccias may be formed under the conditions postulated by Hahn and Grabau. Certain thin-bedded glomerates whose phenoclasts are but slightly abraded, probably owe their origin to such conditions as those observed by Walcott (12) at Noye's Point, Rhode Island. "I noticed that when the tide went out before daylight, the layer of fine sand and mud, exposed to the dry wind and sun during the day, hardened, and that when the surface of the water of the incoming tide was broken by small waves, the hardened layer was lifted, broken into angular fragments and piled, in some places, to a depth of several inches; while in other places it was simply turned over and was very little disturbed. When much disturbed, the edges of the fragments were rounded, so as to give them the appearance of having rolled a considerable distance. In one instance, the ensuing out-flowing tide deposited a thin layer of sand and silt over the brecciated fragments." From these observations it is evident that should the same phenomena occur on a sinking shore line, glomerates of the character so often met with by the field geologist, would be formed. When there has been a special heaping or sorting of the phenoclasts by marine currents, we should expect to find true "edgewise conglomerates." It is conceivable that conditions suitable for the formation of such "edgewise conglomerates" would probably be more or less local within the whole disturbed zone —that is, that a typical arrangement of the phenoclasts might not exist throughout the intraformational glomerates. Walcott does not mention the possible effect of the scouring action of tidal currents upon a previously mud-cracked surface. A tidal flat whose sediments were composed of a limy mud, when dessicated, would, if disturbed by a subsequent and sufficiently powerful tidal action, yield a quantity of tough, not brittle, phenoclasts, which might be redeposited with little or no signs of attrition except at the edges. Ripple-marked and mud-cracked bars and flats are very apt, at the present day, to be dissected by shallow currents, and these channels should act as catch basins into which the phenoclasts derived from the mud-cracked zone are tumbled by the onrushing tide. Agassiz (13) noticed that the lime-mud deposited by the waves of Florida hardened within a few hours to such a degree that it made a ringing sound when walked upon. This scaly deposit becomes exceptionally brittle between tides, and might, under certain conditions of deposition, be broken up by the advancing waves and re-deposited in much the same manner as suggested by Walcott.

(To be continued)

NOTE.

The Editor of THE OTTAWA NATURALIST has frequently been asked, by members of the Club, for information on Nature Guide books. He has thought it advisable to list the pocket guides which are now available, and which may be obtained at The Book Store (A. H. Jarvis), Bank St., Ottawa, or from James Hope & Sons, Sparks St., Ottawa. These are as follows:

The Bird Guide—Land Birds
The Bird Guide—Water Birds
The Flower Guide
The Tree Guide
The Butterfly Guide
The Animal Guide

All of the above are beautifully illustrated in colours. They are invaluable to the nature lover, and in price are $1.00 each.

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