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THE DEVELOPMENT OF CRANGON VULGARIS.

THIRD PAPER,[1] WITH PLATES I, II, III.

BY J. S. KINGSLEY, SC.D.

THE ALIMENTARY CANAL AND ITS APPENDAGES.

IN the preceding account (Vol. XVIII, pp. 109–138, pl. I, figs. 7, 8 and 9) may be found a description of the process of gastrulation in Crangon, together with a summary of the then existing literature of the development of the germ layers in the Arthropods. To this account I would here add a few supplementary remarks, bringing the subject down to the date of writing and also correcting my own observations in the light of my later studies.

Since the article referred to was in type, several papers on Arthropod development have appeared, which have a bearing upon the points discussed. First is that of Morin (**'87**), on the development of spiders belonging to the

[1] Continued from the Bulletin of the Essex Institute, Vol. XVIII, pages 99–153. 1886. Published May, 1887. The numbering of the figures on the accompanying plates is consecutive with that of the preceding part of this series.

genera Theridion, Pholcus, Drassus and Lycosa,—a paper the points of which appear to fully support the views which were advanced in the discussion. In brief, according to Morin, the nucleus of segmentation in the eggs studied by him lies at the centre of the egg and not until the third segmentation does the yolk segment. The segmentation is perfectly regular and not until the one hundred and twenty-eight-cell stage is reached, do the nuclei and surrounding protoplasm reach the surface and form the blastoderm, at which time they separate from the yolk pyramids, which now again forms an unnucleated homogeneous mass. The blastoderm now thickens upon the ventral surface, and from its centre cells are budded inwards, some of which remain between the parent cells and the yolk, while others sink into the yolk itself. As will readily be seen this process, which gives rise to both meso- and entoderm, is easily brought into full accord with the gastrulation in Crangon, and other types. Morin does not regard the "primitive cumulus" as of importance in the formation of the germ layers, since, in his experience, it does not arise until after they are formed; indeed it does not appear at any stage in Theridion. The entoderm nuclei sink into the yolk where they remain distinct — much as I have described them in Limulus (**'85**, p. 530, figs. 45 and 47) —until shortly before hatching.

Schimkewitsch, who has also published his complete paper(**'87**) on the development of Arachnida, differs considerably from Morin in his interpretations. He thinks that only a portion of the products of segmentation migrates to the surface to form the blastoderm, the others remaining behind to form polynuclear yolk pyramids (not seen by Morin) which represent the entoderm. The early appearance of the primitive cumulus and the white spot are interpreted by Schimkewitsch as indicating the limit of meso-

dermal extension, and he regards the latter as limiting the posterior extension of the potential blastopore, and forming the anal lobe, while the white spot (*tache blanchâtre*) is the cephalic end of the future embryo. The mesoderm has a varying origin, according to his text. In some forms it arises from the blastoderm, much as described by Morin, while in others it is produced by budding from the polynuclear yolk pyramids. The plates, however, do not seem conclusive on the latter point but are apparently capable of being interpreted after the manner of Morin. A reconciliation of their different accounts of the origin of the entoderm is, however, more difficult. Schimkewitsch studied Agalena, Lycosa, Pholcus, Epeira and Tegenaria.

Josef Nusbaum has given (**'87**) a brief account of some of the earlier stages of the development of *Mysis chameleo*, but if we are to accept his interpretations of his observations, his description of the origin of the germ layers is not easily reconciled with what is known of the cœnogeny in any other arthropod. He says that the egg before segmentation is surrounded by a blastema and has its nucleus at the formative pole. The first segmentation produces two cells, one of which gives rise to the blastoderm, while the other sinks into the yolk. The larger central cells of the blastoderm later bud off other cells which also sink into the yolk and together with the products of the division of the first cell migrating to that region give rise to "vitellophags" the function of which is the modification of the yolk. Now first appear the rudiments of the germ, the figure which he gives closely resembling my fig. 10. At this time a shallow invagination (*cf.* my fig. 231, *af*) takes place in the caudal area, and the invaginated cells, undergoing a rapid proliferation, from a solid entoderm. Then, *behind* the point of invagination the abdomen is budded forth. The "vitellophags" (to which we shall return later in the present

paper), at first lie just beneath the germinal area but later sink into the yolk, where they finally disappear without taking part in the formation of any organ of the adult. The mesoderm is said to arise from cells budded inwards from the germinal bands.

Nusbaum's account is confessedly preliminary and in default of figures of the sections on which he bases his conclusions, I should have more hesitation in assuming that he had confused the parts of his embryos to a great extent, were it not that a similar fatality had characterized his work in other forms (*cf.* Whitman, **'86**, Clepsine; Grosglik, **'87**, Oniscus, etc.) If, as I have suggested in another place,[1] we assume that Nusbaum has regarded the abdominal flexure as the blastopore, a portion of his results are readily harmonized with those of other students. As will be noticed, from his abstract given above, he places the position of the blastopore *in front of* the place where the abdomen is subsequently to form. But, so far as I recall, not a single other observer agrees with him in this respect. The universal concurrence of opinion, among those who have carefully studied the subject is, that in the Podophthalmia at least, the blastopore is *behind* the tip of the abdomen. The early stages of the formation of the abdominal flexure certainly do simulate an invagination and have apparently been interpreted by Ishikawa (**'85**) as the first inpushing of the proctodeum, to which reference will again be made. In sections of eggs which have undergone contraction during the hardening processes, the space between the folds of the ventral abdominal ectoderm is obliterated, and Nusbaum may have readily interpreted the tissues thus pushed in as a solid entoderm. If the position here taken be valid, all of Nusbaum's other conclusions as to the germinal layers

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[1] American Naturalist, XXI, p. 294, March, 1887.

need revision. He gives a transverse section of his embryo, the figure closely resembling fig. 31 of the present paper, and refers to the deeper cells as mesoderm. If they arise, as he claims, by budding from the outer layer cells, it is probable that he is dealing with nervous, rather than mesodermal, tissues. It is, however, more probable that in Mysis, as in other forms, these are true mesodermal cells and have attained their present position by a forward growth in the same way as will be presently described for Crangon. The fate of the vitellophags will be mentioned later.

The observations of F. H. Herrick (**'86**) upon the development of Alpheus record a state of affairs, so far as gastrulation and origin of the mesoderm are concerned, which is readily comparable with that of Crangon.

Dr. A. T. Bruce, in his complete paper (**'87**), is more in accord with the Hertwigs, than was apparent in his preliminary communication (**'86**) referred to in the second part of this paper. In regard to the formation of the entoderm in Thyridopteryx, this is even more so than in the other forms which he studied. He regards, in all forms, the yolk cells as true entoderm, with vitellophagous functions, and believes the functional entoderm to be of later origin.

Reinhard has recently (**'87**) restudied *Porcellio scaber*, and his results are in fair accord with the interpretation of Bobretzky's researches given in the preceding part of this paper. Reinhard concludes that the egg-nucleus divides, and that some of the resulting nuclei, with a portion of the protoplasm, form amœboid cells, which gradually creep to the surface. The resulting blastoderm, is not at first continuous, but consists of "islands" (*cf.* Bobretzky, **'74,** pl. XXI, figs. 3 and 7). The undifferentiated cells, which remain behind, form the primary entoderm, which soon becomes differentiated into ento- and mesoderm.

Cholodovsky (**'88**) says that, in *Blatta germanica*, the

differentiation of the entoderm forms the lower layer cells until after the closure of the primitive groove, and that then it separates from the mesoderm-entoderm, and later, envelopes the whole yolk. The "yolk cells" form no part of the permanent entoderm, but rather play the part of vitellophags.

Blastopore and Anus.—In stage *A* (fig. 10; section, fig. 9) is shown the process of gastrulation. In describing this stage (*ante*, p. 138), I pointed out that the blastopore was clearly behind the point where the abdomen was subsequently to be formed, but said that I was unable to ascertain whether any definite relationship existed between the blastopore and the anus. A subsequent section, I regard as throwing light upon this point. It is shown in fig. 29, and passes in an obliquely longitudinal direction through the inner edge of the optic lobes, the ventral bands, and through the thoracico-abdominal area. In the latter region, it cuts through two pits, the anterior and larger being the abdominal flexure (*af*), while behind it is a second and smaller pit, which certainly becomes the proctodeum and which I now regard as being at the same time in the position of the blastopore. In other words, the blastopore occupies the same position as the anus and may be actually identical with it.

A comparison of this figure with Ishikawa's ('85) fig. 62 seems to lend countenance to the view that he has interpreted the abdominal flexure as proctodeum. I regard that depression in his figure, behind the letters "*ab*" as the real anus and as homologous with the similar depression in my figure cited. In support of this view, I would point out that in both Astacus (Reichenbach, '86) and Crangon (*vide infra*), the anus is at first on the dorsal and only later attains the position on the ventral surface, which it has in the adult of all Crustacea.

As to the identity of the position of the blastopore, with that of the anus, a word more may be said. The relations of the mesoderm and especially of the entoderm cells, show that the two openings cannot be very far removed from each other, as can be seen from a comparison of fig. 29. with figs. 8 and 9 of the preceding part of the paper. Reichenbach claims in Astacus (**'86**) that the anus is formed a little in front of the place where the blastopore closed, but his figures do not seem to me to fully support him in this point. They rather seem to leave the matter undecided as to absolute identity of position, with the chances in favor of an even closer approximation than the lettering of his fig. 7*a* would indicate. For all that text or illustrations indicate, the "leader" from "*A*," in the figure quoted, seems to be arbitrary in position, while if the letters, "*Th. Abd. F*" be rightly placed in his fig. 39, there is no room between the blastopore and the abdominal flexure for the anus to form. A comparison of these figures with his 49 and 50 do not help the matter in the least. Mayer, in his account of the development of Eupagurus (**'77**),[1] thinks that the anus forms in the position where the blastopore closed, while the fact that Bobretzky at first stated that the blastopore persisted, as the anus, a statement which he later corrected (**'74**, p. 186),—shows that the two in Astacus must be nearly, if not quite, identical in position. Still Reichenbach's statement (*e. g.* **'86**, pp. 42 and 43) is very explicit, and should not be set aside without more evidence.

Entoderm.—The entoderm cells at this stage are comparatively few in number. They are sparsely and very ir-

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[1] Mayer says in effect (*l.c.*, p. 237), that invagination gives rise, not to a true entoderm but to both proctodeal and entodermal tissue. The whole of the hind-gut arises from the invagination, while the cells, which bud from the invagination and pass into the yolk, form the entoderm. This of course is confirmative of the view quoted in the text.

regularly scattered through the yolk but still remain closer together near the region of their origin. Each nucleus is deeply and nearly evenly stained, the chromatin reticulum showing less plainly than in the mesoderm or ectoderm cells, a peculiarity which, however, is lost in the later stages.[1] Each nucleus is surrounded by a thin layer of slightly staining protoplasm which sends off delicate pseudopodal processes between the masses of the yolk. I have never been able to see that the yolk was divided into masses corresponding to these nuclei, as is the case in Limulus (self, **'85**) but in Crangon each nucleus and the protoplasm surrounding it apparently form the entire cell, the yolk being something external and intercellular. Reinhard (**'87**) came to the same conclusion with regard to the entoderm cells in Porcellio. After the first formation of the entoderm by invagination, the resulting cells in Crangon lose their continuity and not until a comparatively late stage, do they again attain the condition of a layer. The large entoderm cells filled with yolk or the secondary yolk pyramids, described and figured by both Bobretzky and Reichenbach in Astacus, do not exist in Crangon. The yolk, it is true, is divided into masses or spheres of varying size but in a very irregular manner, and the nuclei so far as I have been able to discover bear no relation to these. Crangon, as has been said before, is more like Palæmon than like Astacus in its lacking a lumen to the mid-gut, but it differs from Bobretzky's figures of Palæmon in the irregularity with which the entodermal nuclei are arranged in all

[1] It hardly needs to be said that in order to more clearly distinguish between the different germinal layers beyond that afforded by the colors, I have adopted a conventional method of representing the component cells and nuclei in the general figures. In the more detailed drawings, however, I have endeavored to represent the exact histological appearance so far as the reproductive process would allow.

stages as well as in the distinctness of the cells from the central yolk.

After the present stage the changes in the arrangement and character of the entodermal cells are comparatively slight, excepting an increase in number, until a much later stage in the development. They remain scattered irregularly through the yolk and but slowly take a peripheral position. At all stages until shortly before hatching they are closer together in the neighborhood of the proctodeum than elsewhere. With these remarks I will leave the further description of the entoderm until it begins to form itself into organs, allowing the figures to speak for themselves. I have no actual evidence as to migration among these cells other than that afforded by sections. At the time of gastrulation (fig. 9) the yolk is free from nuclei while later they are scattered through it, a fact which would seem to necessitate migration from the point of origin.

To anticipate a little, I may say I believe it is shown by their future history, that these cells are truly entodermal and that a "vitellophagous" career is not their sole function. I have no reason to dispute that they play an important part in most arthropods in the metabolism of the yolk, and hence they are so far vitellophagous. Such was shown to be the case in Astacus by Reichenbach a decade ago. In my paper on the development of Limulus (**'85**, p. 543) I ascribed a similar function to corresponding cells in that form and said that the lumen of the mid gut, and I might have added, of its diverticula, arose from the actual eating of the yolk by these cells. Kowalevsky and Schulgin (**'86**) attribute a similar function to cells occupying the same position in the embryo scorpion, and Nusbaum, I think, has adopted their views too completely in his descriptions of Oniscus (**'86**) and Mysis (**'87**). These authors, however, claim that vitellophagy is their sole function,

but it seems probable that they are also entodermic, and eventually give rise to the epithelium of the mesenteron. If the above explanation of Nusbaum's account of the development of Mysis be correct, his entoderm is nothing of the sort and his vitellophags are apparently the only cells which can supply the lining of the mid gut. Until he publishes his complete account one is left in doubt as to the evidence he has that these cells degenerate and disappear.

Stomodeum and Proctodeum.— Both stomodeum and proctodeum are well marked structures in stage *B* (fig. 11). At this time the proctodeum is a well developed ectodermal invagination (fig. 36) arising behind the abdominal flexure and formed of cells more or less columnar in appearance. Its inner extremity terminates blindly, abutting directly against the yolk, having apparently pushed aside the mesoderm which formerly (fig. 29) formed an unbroken sheet in this region. In the adjacent portion of the yolk are several entoderm cells placed closer to each other than in other parts of the deutoplasm. Behind the proctodeum are a few mesodermal cells, while in front (morphologically below) this layer is much more extensive, reaching forward as a connected sheet (see below under mesoderm) around the abdominal flexure to beyond the stomodeum. In these points my studies are but little more than a confirmation of those of Reichenbach.

The stomodeum at this stage is less deep and it is to be noted that it has not yet broken through the mesoderm nor does it do so until a much later stage. It is also to be noted as is also the case in other forms, that it has not that flexure so characteristic of it in its later stages. In the section figured it has no well marked lumen but in others (which do not show other features so well but which are less contracted by the hardening reagents) it has a much larger cavity in proportion than has the hind gut. At

first its axis is directed obliquely backward but this is soon changed, apparently by a more rapid growth of mesoderm to a nearly similar angle toward the anterior end of the embryo.

From this point until stage *G* the changes are comparatively slight and are shown in figs. 37, 43 and 42 which represent longitudinal sections of stages *E* and *G* respectively. The former does not show the inner extremities of either stomodeum or proctodeum, the section being slightly oblique but in the latter (fig. 42) both are well shown. In both, the stomodeum has become bent, the ventral half being directed upwards and forwards while the inner portion is directed as strongly in the opposite direction. In my sections it appears to abut abruptly against the mesoderm though I cannot state positively that it does.

The proctodeum on the other hand exhibits more marked changes. The anus in fig. 43 is near the tip of the abdomen, but it is to be noted that it has lost its dorsal position and has appeared upon the ventral surface, a feature which is more strongly marked in fig. 42. Its inner extremity forms a wide funnel, the open mouth of which embraces the yolk, which now is seen to be breaking up (*vide* fig. 20 and, later, fig. 23), the yolk granules and balls circulating with a peristaltic motion in the intestine. My series of sections seem clearly to show that the whole of this intestine is of ectodermal origin and that the entoderm has nothing to do with its formation. In stage *H*, fig. 54, the same relations of the proctodeum to the yolk mass are seen, and in the living embryo the movements of the yolk particles are much stronger.

In the same stage (*H*), the stomodeal division of the alimentary tract exhibited some notable changes. At its external extremity, it has become widened out to form a buccal cavity (fig. 238, *bc*) which abruptly contracts to

give rise to the long and narrow œsophagus. The widening of the stomodeum to form the buccal cavity is seen in transverse sections to be in a longitudinal and not in a transverse plane. The œsophagus goes upwards and forwards and then bends abruptly backwards to widen out and form the "stomach" (*gm*). In front of (below) this bend the walls are composed of a single layer of cells, but in the gastric region the epithelium becomes thickened in places, as can be seen in figs. 62, 63, 64, 65 and 66. In fig. 64, which cuts both limbs of the stomodeal invagination near the angle, the gastric portion is seen to have its lumen in the shape of a St. Andrew's cross, the result of a thickening of the epithelium in four places, while at the angles it is but a single cell in thickness. This is apparently a provision for the subsequent distention of this region into the large cardiac sac of the adult, a distention not yet possible, on account of the comparatively large amount of yolk not yet metabolized.

Farther back (figs. 54 and 65), the lumen is much larger and is vertically compressed, while its walls are thinner. There are, however, to be recognized in this region, three thickenings—one ventral and two lateral—which correspond in position and doubtless give rise to the future folds of the pyloric division of the stomach (*cf.* Mocquard, '83, p. 230). At this stage (excepting that the cuticle and straining hairs are not yet developed) the pyloric portion of the stomach corresponds closely in section with the similar region in the adult amphipod Gammarus. At this stage (*cf.* fig. 54) the stomodeum certainly opens directly to the yolk, there being not even a mesodermic partition existing between.

The foregoing account is in close accord with that of Reichenbach ('86) in almost all details except in the communication of the stomodeum with the yolk cavity

which takes place in Crangon at an earlier date than in Astacus. The muscular system of the "stomach," on the other hand, is much later in development than in the form studied by Reichenbach, as the walls do not before hatching acquire a marked muscular appearance.

ENTODERM.—From the time of gastrulation until shortly before stage *H*, the history of the invaginated entoderm can be briefly told. At first the cells remain in proximity to the blastopore or anus, but (fig. 29) they have no intimate connection with the rest of the germ. They are, rather, isolated cells in the midst of a large mass of yolk, each cell consisting of a comparatively large nucleus surrounded by a thin pellicle of protoplasm which exhibits a tendency to extend in pseudopodal prolongations at the angles.

With development the entoderm cells wander farther from the point of origin and remain scattered through the yolk, for a long time uniting neither with their fellows nor with the other germ layers. Their division is not rapid until stage *G* is reached, when they begin to multiply more rapidly and to give rise to an epithelium by joining themselves together.

Owing to the solidity of the yolk and the absence of well defined yolk balls in Crangon, it is difficult to ascertain the relationships of the entoderm cells to the yolk in their pre-epithelial stages. Several facts, however, lead me to the view that they are not to be regarded as the centres of yolk balls, but rather as forming a potential if not an actual reticulum, in the meshes of which the yolk balls occur. This view is in full accord with that of Mayer (**'77**, p. 237) of the relations of the entoderm cells in Eupagurus and in Porcellio (Reinhard, **'87**); but differs from Palæmon where Bobretzky (**'73**) found these cells forming the centres of yolk balls.

Of stage *G*, my series of sections is not good enough to show conclusively the steps followed by the entoderm cells at that stage, but in stage *H* there is no doubt of the part they play. They have become distributed through the yolk, have multiplied rapidly and have begun to arrange themselves into an epithelium, the lobes of which are not yet continuous with each other. It is difficult (or even impossible) to obtain a single section which will show the relation of these isolated patches of epithelium to each other, but from a series of sections it is clearly seen that at this stage (*H*), there are three pairs of well-marked lobes, and that these are from the first distinct from each other.[1] Of these the first, with its mesodermal envelope, abuts directly against the brain and are shown in sections (fig. 59) passing through and just behind the compound eyes. The second pair (fig. 64) are at about the level of the cardiac portion of the stomach, while the third pair, which are the best developed, are just in front of the broad funnel-shaped internal opening of the proctodeum. One of this pair is shown — a little out of its proper position with regard to the median line—in fig. 54, while in fig. 68 the plane of the section cuts across its posterior extremity, and fig. 67 shows that it has a considerable extension towards the sides of the body. All of these lobes are characterized by having the cells well developed and partaking more or less plainly of the nature of a columnar epithelium, while in the sections which pass between these lobes (*e. g.*, figs. 63, 65) the entodermal cells are scattered, and it is difficult, if not impossible, to trace any protoplasmic connections existing between them.

In fig. 70 is a more careful drawing, on a larger scale,

[1] Nusbaum ('86) claims that in Oniscus the second pair of liver lobes arise from the splitting of the first pair, and Reinhard ('87), studying Porcellio, confirms him.

of a section across the tubular portion of the left posterior liver lobe which shows better the histological structure of the epithelium. The cells are distinctly columnar, and, stained with alum cochineal, the nuclear reticulum shows well. The nucleus occupies about half the cell and the protoplasm outside is slightly granular and stains but slightly though exceeding the nucleus in that respect. The lumen of the follicle is filled with yolk, but the distinction between yolk and cells is not very clearly marked. The inner ends of the cells are irregular and somewhat pseudopodal in character and the protoplasm in the same region is more granular than that at the opposite end of the cells. This granulation is apparently due to the yolk which is being taken into the cell at this point and is being metabolized in an amœboid manner, much as described by Reichenbach (**'76**) in his first paper and by several later authors upon Crustacean development.

From the foregoing it appears clear that the entoderm cells give rise directly to the so-called liver and that this organ does not arise by diverticula from the main portion of the digestive tract. It would also appear, that in the early stages at least this organ does not really deserve the name of liver, but should rather receive the name given it by Frenzel (**'84**) of midgut gland; but as yet it does not fulfil his characterization of it in the adult (p. 99): "Dass die Mitteldarmdrüse [der Crustaceen] die Function einer Verdauungsdrüse besitzt, welche in ihrer Wirkung mit dem Pancreas der Wirbelthiere eine grosse Anlichkeit zeigt."

A difference is to be noted in the development of the liver in Crangon from the process described by Reichenbach (**'86**) in Astacus. In Crangon all the liver lobes at first lie above the digestive canal; in Astacus they extend beneath the ingrowing stomodeum and stomach.

In Palinurus (Dohrn, **'70**, 126–127), the liver arises by

the formation of separate epithelial caps which later grow together as in Crangon and produce the lobed condition of the adult. In Cuma (Dohrn, *l.c.*, p. 6) : The liver "besteht aus einer mässig gewolbten kuppelformigen Erhöhung, deren Basis ringförmig eine Oeffnung umschliesst, durch welche die communication des Lebersackes mit dem Dotter, später mit dem Darme stattfindet." All of which agrees well with what is given above.

I regret that the material at hand does not decide more definitely the question of how much of the alimentary canal is of entodermal origin, but I think the inspection of the figures referred to in connection with this section of the present article will show that scarcely more than the "liver" and its ducts can be derived from the entodermal cells. Views of living specimens at a later stage than that represented in fig. 23 show that the hind-gut extends itself still farther forward, its inner termination retaining its funnel-like expansion. Up to the stage represented in fig. 54 the approximation of proctodeum and stomodeum has been effected not by additions from the entodermal cells but by cell division in these regions of true ectodermal origin. As in later stages, after hatching, the whole middle region of the alimentary tract retains a uniform histological structure it seems but fair to infer that the whole of its extent has a common origin. In other words, I believe that the whole of the straight canal is produced by the stomodeum and proctodeum and that the entoderm is limited to the liver or mid-gut gland of Frenzel, and the immediate vicinity of its ducts.

It will readily be recalled that this view is not new. A close parallel will be found in Oniscus as described by Bobretzky ('74). There the straight part of the tract is described as being formed exclusively of stomodeum and proctodeum while those cells which, in the former part of

this paper ('86*b*) pp. 134–136, I have shown to be true entoderm are utilized almost wholly in the formation of the voluminous liver. Between Oniscus and Crangon, as is to be expected, there are minor differences. In Crangon, as we have seen, there are six (three pairs of) liver lobes outlined at first. In Oniscus, on the other hand, the structure is more simple. In this connection it may be noted that Balfour, deriving his facts from Bobretzky, says ('80, p. 439) that in Oniscus the alimentary tract "is mainly if not wholly formed from the proctodeum and stomodeum," while on the next page he thinks that the entoderm cells, besides furnishing the hepatic epithelium, "probably also supply the growth material for the later growth of the apparent proctodeum" and on this account this portion of the digestive canal "does, in reality correspond to the proctodeum and mesenteron together."

Looking at Oniscus alone, as described and figured by Bobretzky, it seems to me that the whole alimentary tract, from the openings of the hepatic ducts to the anus is strictly proctodeal in origin, while the light thrown upon the subject by Crangon seems to confirm this view. The yolk or entoderm cells in Crangon are larger, and differ in their histological characters from those of the hind gut, and I have never seen a trace of their joining themselves to that part of the canal. On the other hand, they seem to remain in a passive condition until a comparatively late stage when they unite, not to piece out either ingrowing portion but to form the hepatic epithelium.

In Astacus the resemblances would naturally be closer and so I regard them as shown in Reichenbach's ('86) figures, especially in his Pl. XIV, fig. 217. His letter "*D*" ("Ubergangstelle des Mitteldarms in den Hinterdarm") seems to have an arbitrary position while his "MD_3" ("dor-

saler Mitteldarmblindsack") is comparable to my middle liver lobe.

It would appear that Reichenbach felt compelled to recognize entoderm in the canal proper, for a digestive tract without entoderm seems an anomaly. Fore- mid- and hind guts are universally quoted, but their limits are far from recognizable in either young or adult. Thus in Palæmon according to Bobretzky ('**75**) as abstracted by Hoyer, p. 318, "Die Kern-haltige peripherische Schicht der den Darmdrüsenkeim bildenden Pyramiden hebt sich als gesonderte Zellenschicht von dem centralen Doltermasse ab, die durch Einschnurung in zwei vordere und zwei hintere Ballen zerfällt, und bis zum Ausschlüpfen der Larve völlig verbraucht wird. Der eigentliche Mitteldarm schnürt sich durch einfache Faltenbildung von den oberen Wand des Darmkeimes ab, wahrend der Rest des letzeren allmälich in Leberkanalchen sich zerklüftet." This, as will be seen, agrees with my account of what occurs in Crangon, due allowance being made for the different character of invagination, except in the cutting off of the midgut proper. But we are left in doubt as to the extent of this 'eigentliche Mitteldarm.' In this fact that the entodermal cells give rise to the liver is possibly to be sought the source of Nusbaum's view ('**87**) already adverted to, that the vitellophags of Mysis degenerate. He was looking for the entodermal portion of the alimentary tract in the straight portion of the canal, and being unable to trace them into any portion of this and, failing to recognize that they gave rise to the liver, he was at a loss to explain their fate in any other way.

In connection with the method of formation of the alimentary tract proper which I have described in the foregoing pages, it is interesting to note the condition which

occurs in the Cephalopoda according to the observations of S. Watase (**'88**). Studying both *Loligo pealii* and an unknown West Indian species of cephalopod this author concludes (p. 178) "As to the origin of the digestive tract with its appendages, I found it to be entirely formed by the ectodermic invaginations, that is by the prolongations of the proctodeum and the stomodeum." Of course this is but analogy and the cephalopod differs from Crangon in having, according to Watase, none of its diverticula derived from the morphological endoderm.

To account for the strange condition which he describes Watase has recurrence to the modifying influence of the immense food yolk. "In the Cephalopod the endoderm becomes the yolk digesting membrane, and before it can dispense with this function, the prolongations of the fore and hind guts complete the digestive tube and exclude the endoderm, which itself becomes absorbed later." Though there is a tendency to a belief that food yolk is called upon to explain more than it ought to explain, I feel confident that in both the cases of Crangon and the Cephalopods it affords a valid reason for the conditions described.

The change in the position of the anus is interesting. At first it is distinctly dorsal, a condition not uncommon in the adults of many annelids, while by the outgrowth of the upper margin of the opening it soon becomes terminal and at last, long before hatching, it assumes its crustacean position on the ventral surface.

"DORSAL ORGAN."

In figures 37 and 39 are shown two sections of the problematical structure which I have already referred to as the "dorsal organ". I have nothing to add to the account which I formerly gave of it in this *Bulletin* (Vol. XVIII, p. 149, pl. II, f. 19). It is solely ectodermal, and so far as

my observations go, only is seen in stage *C*. In the later stages there is nothing to be seen in this region which could be regarded as a derivative from it, unless it be the hinder margin of the carapax, shown in figs. 42 and 54.

NERVOUS SYSTEM.

At about the earliest stage at which any rudiments of organs appear we can distinguish roughly the outline of the nervous system. In figure 8 (this Bulletin, Vol. XVIII) which represents a surface view of the gastrula stage, there is shown an aggregation of ectodermal cells in front of (below in the figure) the blastopore. Comparison of this with figure 10 of the same plate, and with fig. 1 of my paper on the development of the eye (**'87**) show that in this aggregation we must recognize, not only the rudiments of the thoracic-abdominal area but of the nervous system as well. In fig. 10 (reproduced at a slightly later stage in fig. 28) we can clearly see the two oval optic lobes and leading from them backwards two cords of cells, the rudiments of the future cords, reinforced, as shown by sections, by a deeper layer of histologically different cells which I interpret as mesodermal bands (see figs. 29–31). These ectodermal nervous rudiments are composed of cells more columnar than those occurring between and the nervous system may be described as a pair of longitudinal thickenings which are as yet unconnected in front, and are but a single cell in thickness.

In stages *B* and *C*, much the same conditions are retained except that the nervous system is several cells thick, but a study of figure 11 makes it evident that we must consider *all* of the ganglia of the nervous cord, except those connected with the eyes, as primitively belonging to the post-oral series. I may say here that I am inclined to believe that I fell into error in my account of the development of

the Compound Eye of Crangon ('86*a*) and that the invagination or inpushing which I there described as giving rise to the ommatidial layer of the eye, in reality gives rise to the ganglion of the eye which in the adult is contained within the ophthalmic stalk. It forms the anterior outer portion of the tract lettered "*ol*" in figures 11, 12, 28, 32, etc. Behind, and nearer the median line a second ganglion is formed (g^1, in figures 33 and 34) which is clearly preoral and is as clearly not connected with the first antenna, which appendage is still distinctly behind the mouth. This, I regard as the primitive prestomial ganglion, equivalent to the supra-œsophageal ganglion of the annelids.[1] Behind the mouth (fig. 35 *na*) is shown a somewhat paired ectodermal thickening which is clearly the ganglion of the antennula. Sections passing through the second appendage show a condition of affairs essentially the same.

None of my transverse sections of stages *D*, *E* and *F*, proved satisfactory, and between stages *C* and *G*, many changes occur which can be but imperfectly studied in my drawings of the external appearance (figs. 14--18) and in the longitudinal sections represented in figs. 38 and 41. In stage *D*, fig. 14 shows an "optic lobe" (*ol*) which, from the preceding paragraph, is seen to be made up of optic elements and an optic ganglion proper—a primitive supra-œsophageal ganglion (*og*) and two ganglia (*sg* and one behind it, unlettered), belonging to the two pairs of antennæ. In a longitudinal section of the same stage (fig. 38) it is seen that the prestomial region of the nervous system (*og*) has considerable longitudinal development while behind the

[1] Owing to the fact that my drawings were made at different times, and that my views on the development of the nervous system have undergone serious alteration during the progress of my studies, there will be found some confusion in the reference letters in the plates on those parts that refer to the brain. In the text I have endeavored to straighten this.

mouth an ectodermal nervous thickening extends the length of the thorax and abdomen. A transverse section behind the mouth (fig. 40) shows the ventral cord an unbroken band extending from side to side.

In *F* (fig. 43), the cerebral region is much larger, and near the median line three ganglia are to be seen, the boundaries between them not having as yet been obliterated. These three ganglia unite to form the "brain" of the adult, and represent respectively, *og*, the primitive cerebral or prestomial ganglion of the prenauplius condition; g^1 the antennular and g'' the antennal ganglia of the primitive ventral chain. I have not traced out their derivatives in the complex brain of the adult nor have I at any time seen traces of the division of the first antennal ganglion which Reichenbach describes (**'86**, p. 67) as giving rise to the "Vorderehirnanschwellung" and "Seitenhirnanschwellung" of Dietl and Krieger.

In stage *G* is noticed for the first time a differentiation of the nervous system into ganglion cells and fibrous substance. I have not traced the processes sufficiently to add anything new to what is known of the processes of histogenetic alteration, but would call attention to the cells and nuclei labelled "*nc*" in figs. 47, 48, 57, 58 and 59 which are undergoing metamorphosis. These nuclei appear much clearer and stain less deeply than their fellows and the protoplasm of the cells as well as that of the nuclei is becoming more granular and exhibiting a tendency to be arranged in bands, while in some cases the nuclear wall is breaking down, steps in the process of conversion into the neural "Punct-substanz" of Leydig. Fig. 46 passes through the cerebral and antennular (g^1) ganglia and the connective uniting them. In fig. 48 is shown the commissure (cm^2) connecting the antennular ganglia of the right and left halves of the body, while cm^3 in fig. 48 shows the commissure between the antennal ganglia.

In fig. 42 the ganglia of the ventral thoracic chain are already seen to be differentiated by the appearance of fibrous portions (dotted in the figure), while no such structure is visible in the abdomen. Here, however, the ganglia are separated by the rudimentary flexor muscles (*mu*) extending downward to the ventral surface. From sections 46 to 49, we see that in stage *G* there are a cerebral ganglion proper and two antennal ganglia in front of the mouth; a count of those shown in fig. 42 shows sixteen in the ventral chain, of which seven are abdominal, a total of nineteen, leaving two to be added to the thoracic region.

In stage *H* (figs. 54–71) there is a considerable advance, represented diagrammatically in the last figure (71). In 54 we see that the brain is of considerable size, and that two of its masses of transverse commissural fibres are large. Behind the mouth and œsophagus the ventral chain is well shown nearly to the anal opening. It is, however, noticeable that nowhere has it yet separated from the parent ectoderm.

In the cerebral region several features may be mentioned. In fig. 55 transverse commissures are seen connecting together the two members of the first pair of ganglia. Three sections back (fig. 56) we see two bands of fibres the outer of which (*fo*), as the next figure shows, is connected with the eye, while the other (*fc*) can be traced in the sections not figured, to the *cm′* of fig. 55. In figs. 57 and 58, the latter a more magnified representation of the former, a process is clearly seen which I interpret as a breaking down of certain of the ganglion cells and their nuclei and a modification of the protoplasm into nerve fibres. In the centre of fig. 57 (cm^2) is seen the section of a second commissure uniting the two halves of the "brain," while in fig. 59 (two sections farther back), these are again separated (*cv*) and serve to connect the two ganglia of the same side and the anterior bend of the œsophagus and its

mesoderm are coming in between the two halves of the brain, which in the next section (fig. 60) are completely separated by the alimentary canal. In this last section we see two bands of fibres, the outer (n') being the fibrous portion of the nerve going to the antennula.

A review of this foregoing shows us that the "brain" at this stage is composed of three pairs of ganglia—optic, primitive-cerebral and antennular, the antennal having not yet moved forward beyond the œsophageal collar; and although the two pairs of antennæ have acquired a distinctively prestomial position, these nervous centres have delayed in the movement. This condition at once recalls the structure in the adult Apus, where Zaddach (**'41**, pl. III, fig. v) years ago showed that both antennal nerves rise from the œsophageal commissures though Pelseneer (**'85**) showed that the corresponding ganglia had moved forward to join the primitive brain, although the nerves had tarried behind.

Of the nervous structures behind the brain at this stage but little is to be said beyond what the figures themselves show. I would call attention, however, to the fact that at this stage the fibrous portions are central and the ganglion cells surround them in the cephalothoracic region, and that this condition persists (fig. 72) in the hatched zoea. In the abdomen (stage *H*), the fibres are superficial as in the adult (fig. 69).

In fig. 66, which passes through the sixth pair of appendages, may be noticed a couple of patches of pigment, the meaning of which I do not understand. At a little later stage, similar patches appear in pairs in all of the post-oral segments in such a way as to suggest that they may be remnants of segmental sense-organs of the ancestral annelid. In surface views, as well as in sections, they appear quite similar to the "nauplius eye," as it appears (figs. 17, 18, 20, 54, 56 and 73 *oc*). My observations on these

pigment patches, as well as on the ocellus, are very fragmentary, and concerning them and the further development of the nervous system, I have at present nothing further to offer.

A comparison of the development of the nervous system of Crangon with that of Astacus, as described by Reichenbach, is not an easy task, since my sections show but few of the structures he figures and describes. In that form (*cf.* Reichenbach, **'86,** pp. 64–65), the primitively postoral ganglia of the brain move forward at a much earlier date than they do in Crangon, and the fibrous portions of the chain are correspondingly precocious in their appearance. Nothing like the middle cord and thrice divided lateral cords of Reichenbach appear in Crangon, at least until after hatching, nor have I seen any division of the first antennal ganglion to form the " Seitenanschwellung."

MESODERM.

In the previous part of this paper, the mesoderm was described as arising from the anterior and lateral margins of the blastopore. It retains its primitive condition and exhibits no differentiation until about the stage *A*. Then as shown in sections 29, 30 and 31, it has increased considerably in extent and has crowded itself between the ecto- and entoderm, reaching to a point a little behind the blastopore or anus. In front, it has spread out beyond the region of the abdominal flexure. A series of transverse sections at this stage show that the layer is essentially circular in outline, except for two lobes which reach forward a short distance on each neural band. Fig. 31 represents a section passing through the neural band of either side, the region of which may be recognized by the columnar character of the epithelial cells, while beneath each band may be seen

the mesoderm.[1] Neither at this nor at any other stage have I seen any "secondary mesoderm" like that described by Reichenbach (**'76** and **'86**, and Ishikawa **'85**).

With growth the mesoderm spreads in all directions except that the bands mentioned above do not meet in the middle line of the thoracic region until a comparatively late stage (see fig. 40), though they do farther forward (fig. 35). At stage *C* these bands have reached the level of the stomodeum and partially surround its inner extremity, thus giving origin to the muscles of the gastric mill and œsophagus, to be developed later (fig. 35*m*). Still other portions extend further forward reaching (figs. 37 and 41) to a point in front of the eye. Behind the thoracico-abdominal fold the mesoderm is more developed, while at the anterior margin of the fold and near the tip of the abdomen there appear certain large cells (figs. 36, 37, 41, 51 *gc*) belonging to both meso- and ectoderm (and which, in fact, appeared still earlier, fig. 29). These cells must be regarded as budding cells and at once suggest comparisons with the large mesoderm cells described by so many authors among the annelids and notably by Dr. Whitman (**'78** and **'87**). It is in just these regions that growth occurs. The young shrimp when it hatches from the egg has its abdomen with the normal number (7) of segments. The cephalothorax, too, is complete in its appendages in front (see fig. 27); but the series stops with the second maxilliped, leaving six pairs to be produced in subsequent growth. The anterior region of these growth cells nearly, and I believe (though I cannot say with certainty) exactly correspond with this region which is afterward to produce the missing portions of the thorax. So, too, in the tip of the abdomen we find another region for the intercalation of new

[1] By an error, the planes of the sections in figure 29 are wrongly numbered. The figures 30 and 31 should be transposed, as will be seen by a comparison of the corresponding figures.

segments. In stage *C* the abdomen is short and the anus is still dorsal in position. A little later, stage *E*, it is terminal and plainly (fig. 51) these budding cells are adding to the length and taking part in the transposition of the anus from the dorsal to the ventral surface of the body. In this condition it is to be noted that these germ cells belong to both ecto- and mesoderm and thus present close resemblances to the "neuroblasts" and "mesoblasts" of Dr. Whitman. The number of these cells vary. In transverse section I have seen as many as eight in either layer at the tip of the abdomen, but not so many in the thoracic zone of growth.

It is not until stage *F* that there begins to be much differentiation of the mesoderm, but it is to be noted that at this, as well as later stages, the mesoderm of the appendages is solid and I have not been able at any time to recognize a well defined cœlom. Occasionally cavities, formed by splitting, in the middle layer but whether these are to be recognized as schizocœlia or as blood vascular spaces cannot be decided by any evidence at hand except on the theoretical grounds advanced by Lankester ('88 and elaborated for Peripatus by Sedgwick ('88).

The Heart.— The heart begins its beating in stage *F*; it is then but a linear tube which becomes obliterated in the sections, and I have no information as to whether it arises by a splitting of the mesoderm or as a remnant of a theoretical segmentation cavity as suggested by Bütschli and Schimkewitsch. My sections unfortunately show almost nothing of its development except that it appears as a differentiation of a slender dorsal vessel arising in the dorsal mesoderm and apparently (fig. 54) in that portion usually recognized as splanchnoplure. In stage *H* the heart has become well developed and, as observations on the living embryo show (fig. 21), consists of but a single layer of cells with a single ostium on either side. In the early stages the ophthalmic artery is the most conspicuous, appearing as

a well marked tube in all of the anterior transverse sections of stage *H* (figs. 57, 59, 60, 62-65, *d*). The superior abdominal artery is much less marked, while neither in the living embryo nor in my sections have I seen traces of other arteries than these. In view of the fact that in the adult the ophthalmic artery is the smallest of the five arising directly from the heart, its prominence at this stage seems strange until we consider that the hepato-gastric and sternal arteries would have to supply regions which at this time are charged with food yolk, while the enormous eyes are far removed from the deutoplasm and must have all nourishment brought them from a distance.

Cephalic Mesoderm.—The mesoderm, which in stage *C* had extended itself into the region in front of the mouth, remains comparatively unmodified until about stage *F*. In the median line (figs. 42 and 43 *m*) it appears as a moderate patch extending in the former down between the ganglia. A better view of its extension can be gained in fig. 48, where, in the median line, it is a thick mass sending out a narrow sheet on either side, from which a strand stretches upwards, while another goes outwards and downwards (as shown by fig. 49, taken from the same embryo five sections farther back) into the region of the first and second antennæ. In stage *H* the central patch is largely utilized in forming the muscular wall of the œsophagus, while the lateral portions (figs. 55–61) retain about their former position, but send (figs. 56, 57 and 58) a band between the ommatidial elements and the optic ganglion. It is to this layer that I referred in my preliminary account of the compound eye of Crangon('86*a*)as intruding between the ommatidial and ganglionic layers and giving rise to the intrusive mesodermal pigment surrounding the nerve fibres in that region. I did not and do not regard this as in any way giving rise to the pigment surrounding the pedicels, which clearly arises from the ectoderm.

It is the manner in which this intrusion of the mesoderm takes place which forms one of the important objections to my published ideas regarding the development of the compound eye. According to my former account I regarded this layer as insinuating itself into the cavity of invagination, from the walls of which I then believed arose, on the one hand, all of the ommatidial elements beneath the layer of Semper's nuclei, and on the other, the optic ganglion. But the invagination in question actually takes place on the other or dorsal side, and to have the mesoderm creep into such a cavity involves its breaking through a solid ectodermal wall. I now believe that the invagination referred to plays a part in the formation of the optic ganglion, while the eye itself arises from a proliferation of the ectodermal cells, and that this mesoderm extends itself between the two thickenings thus produced. With this view other difficulties surrounding my account of the development of the eye disappear.

Green Gland. — The green gland or antennal gland must be enumerated among the mesodermal structures. It will be recalled that a patch of mesoderm was described as stretching into the base of the antennæ and is shown (figs. 49 and 50) as forming a solid mass without a lumen. In stage *H* (figs. 60 and 61) a cavity appears in this tissue and the cells lining it take a well-marked epithelial character, their boundaries being distinct, while those of the remaining mesoderm retain their primitive character. As yet there is no connection with the external world and the convolutions of the gland are but few, the most contorted portion being that figured in fig. 61 *gg*. So far as my sections show, neither at this nor at any other stage does the green gland have any connection with any other cavity inside the body, a fact which was once regarded as affording serious difficulties in the way of regarding it as a segmental organ and which may have led Reichenbach into

his apparent mistake regarding it. The external opening to the gland is not formed until after hatching. Fig. 74, which passes through the end of the duct, was drawn from a section which escaped the rest of the tube.

In both of his papers (**'76** and **'86**) Reichenbach claims that in Astacus the green gland is of ectodermal origin. Between these two dates, Grobben (**'79**) clearly pointed out Reichenbach's mistake and showed that the gland belonged to the mesodermal tissues. Still, in his later paper (**'86**), Reichenbach holds to his former opinion. If he were aware of any other view or of Grobben's criticism he does not show it; for he neither replies to it nor quotes it, but merely repeats his earlier account. I confess it is not easy to reconcile Reichenbach's fig. 125 and 126 with my studies of Crangon; for if the diagrammatic cells and conventional tinting are to be trusted, the green gland in Astacus must be derived from the ectoderm, unless the duct form long before the rest of the gland. Ishikawa's observations on the origin of the green gland of Atyephyra (**'85**), do not afford a solution of the difficulty; for although he claims that the gland is ectodermal, his published figures do not conclusively settle the question. I have no doubts that the gland in question is mesodermal in Crangon, and that it should be placed in the category of segmental organs or nephridia.

Sedgwick's recent researches on the embryology of Peripatus throw much light on the morphology of the cœlom and of the nephridia in all of the arthropods, and seem to substantiate Lankester's view that the so-called body cavity of these animals is not homologous with the cœlom of the Annelida. According to this view the spaces in the body of an arthropod (blood sinuses, etc.) are all in connection and communication with the circulatory system and must be regarded as portions of a blood vascular room. In Peripatus, on the other hand, the true cœlom has no connection with the circulatory system or with the general body

cavity. It becomes divided at an early date into a dorsal genital cavity and into a ventral series of paired nephridial cavities, and throughout life the nephridia have no connection with the general body cavity, but are covered with a thin membrane, the dorsal cœlomic spaces never extending beyond the expanded inner ends of the segmental organs.

If a similar view be adopted with regard to all arthropods it will readily be seen that both antennal and shell glands must fall into full accord with the nephridia of Peripatus and were they to communicate with the so-called body-cavity (blood-vascular space) their claims to the position here assigned them would be weakened to a considerable extent.

In connection with these studies of the development of Crangon several questions have suggested themselves, a few of which may be briefly mentioned here, though a full discussion of them would require volumes as well as a special knowledge of the details of the morphology of segmented animals which few possess.

As has already been suggested in this series (**'86***b*, p. 147), the Nauplius cannot be regarded as the adult condition of any crustacean and thus have an ancestral value. It is rather to be regarded as an introduced feature in the development of the ancestors which, though frequently masked, is more or less clearly distinguishable in all of the class. Its introduction into the series and its later tendency towards obsolescence are, in my opinion, to be attributed to paucity and abundance of the much-abused food yolk.

A careful consideration of the distribution of protoplasm and deutoplasm in the crustacean egg will, I think, show that the latter is an element which has been introduced at a comparatively recent date. In those eggs where the developmental history shows us that food yolk has long been present, we find it either uniformly distributed through-

out the egg, or aggregated at one pole of the ovum. In the Crustacea and other Arthropods, as I have already shown ('86*b*, pp. 103, 112 to 138) and contrary to the usual characterization, the *yolk is superficial and the protoplasm central*, just as we might expect it to be in an egg, the mothers of which had only recently acquired the capacity of providing the growing germ with an abundance of nourishment. Then, too, the character of the segmentation, which as I have also shown (*l. c.*) is neither superficial nor centrolecithal, but is regular and total, is like that of an alecithal egg, and the food yolk has not long enough been present to modify but slightly this regularity and totality.

Now it is admitted by all that the Crustacea have descended from the Annelids and from some member of that group where there were a considerable number of segments. The persistence of several modified segmental organs in the Crustacea,[1] indicating at least the inheritance

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[1] The antennal glands, coxal glands, and so-called shell glands, are clearly derivatives of the nephridia of Annelids, with which they agree in position, function and to a certain extent in structure, if due allowance be made for the almost total obliteration of the cœlom and the absence of cilia in the Arthropods. To this series, which represent the second and fifth segments of the body, I would here state my belief must be added still others in both Crustacea and Arachnida. In the decapods, for instance, the genital openings are paired and open at the inner bases of the legs, but the position of that opening varies in the two sexes; being in the female at the base of the eleventh and in the male of the thirteenth pairs of feet. This diversity in point of opening of the genital glands in the two sexes of the same species is, it seems to me, inexplicable upon any other ground than that the oviducts and *vasa deferentia* are themselves modifications of pre-existing metameric organs, and the only organs in the annelids which would answer the requirements of the case are the nephridia. This view is rendered more probable from the fact that in many annelids the nephridia are at once organs for carrying off nitrogenous waste and generative products as well, while in others (*e. g.*, Lumbricidæ) certain of these organs become modified for carrying off the male and others the female reproductive elements. In this connection, too, it is to be noticed, that while I have made no observations on the development

of thirteen annelidan segments, is alone sufficient to prove this. Then, too, we know that this ancestral many-segmented form must have crossed the line between the annelids and the arthropods, because nowhere among the annelids do we find any form which can in any way be compared to the Nauplius. That the archaic crustacean possessed many ancestral features which do not appear in the Nauplius can be seen from a study of the appendages of Apus, which as Lankester ('81) has shown (rather than that di- or trichotomous condition which is so often assigned that position) must be regarded as the primitive and typical crustacean appendage. Now, a comparison of the thoracic appendages of Apus with the parapodia of some of the more generalized worms belonging to the Polychæta (Errantia) shows clearly that it is from the latter that the crustacean foot has been derived.

Now it is reasonable to suppose that no matter what the effects be on the young and on the race, it is an economy to the parent in an oviparous form to send the egg out with as small an amount of food yolk as possible, and then the young finds it to its great advantage to escape from the egg at as early a date as possible, provided it be equipped with the necessary organs for playing its part in the world and depending upon the efficiency of these for obtaining food sufficient not only for its immediate wants, but for repro-

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of genitalia in Crangon, Sedgwick ('88) shows that in Peripatus the dorsal portion of the cœlom becomes restricted to the generative area, so that if the ovary and testis of the Crustacea be homologous with those of Peripatus, the relations to cœlom remaining the same, the resemblances between the genital and segmental ducts will be even more striking. The modifications of the primitive nephridial tubes of the vertebrates into generative outlets will also suggest themselves in this connection and their pertinence to the present discussion will be more obvious when we remember that in many respects the vertebrates are more vermian than are the Arthropods.

ducing the structure of the parent. In the Nauplius there is little that is non-essential in an Arthropod, and we must regard it as an embryo of the type just mentioned. It has an alimentary tract, traversing an unsegmented body, a median eye, and three pairs of appendages, the first sensory, the other two pairs at once natatory and fitted for the comminution of food. The most salient features in subsequent growth are the elongation and segmentation of the body and the addition of more appendages posteriorly. It is noticeable that with increase in food yolk there is a marked tendency towards obliteration of the nauplius stage in the Crustacea; in fact, it may really be questioned whether the so-called nauplius stage in the decapods and tetradecapods exists only because of inheritance from such an ancestor or whether it be but a necessary sequence of metamerism, for in any segmented animal the anterior are the first parts to appear and hence in all there must be a time in development when but three segments exist. Of course it should not be forgotten that a free-swimming nauplius stage occurs in Lucifer and Penæus, and that Lucifer, at least, has an egg in which food yolk is not abundant.

SUMMARY.

1. The arthropod egg is not to be regarded as centrolecithal and having a superficial segmentation but as having a central segmentation, the blastoderm being formed by migration of the resulting cells to the surface.

2. The primitive groove in the Arthropods is a modified blastopore, and the absence of invaginated entoderm in some forms is to be explained by Cope's and Hyatt's theory of acceleration and retardation.

3. In Crangon the anus occupies the position of the blastopore.

4. In Crangon and many other Crustacea the young germinal area is actually larger than the much older embryo.

5. All of the appendages belong to the primitively post-oral series, and the appendages move forward more rapidly than the corresponding ganglia.

6. There are indications of segmental sense organs in every segment of the embryo.

7. The alimentary tract proper is nearly, if not entirely, formed from the proctodeal and stomodeal invaginations, the entoderm giving rise to nothing but the liver.

8. The green gland is mesodermal in origin and belongs to the category of segmental organs.

9. The genital ducts are modified nephridia.

10. The nauplius is an introduced feature and represents no adult ancestral condition in the crustacean phylum.

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EXPLANATION OF PLATES I, II AND III.

The numbering of the figures is consecutive with that of the preceding part (Vol. XVIII, pls. I and II).

REFERENCE LETTERS.

a abdomen.
af abdominal flexure.
an anus.
ap appendage.
bc body cavity.
bg boundary between optic and cerebral ganglia.
bl blastopore.
c cerebral ganglion.
cc crystalline cone.
ch chorion.
cl corneal lens.
cm commissure or commissural fibres.
co body cavity.
ct cuticle.
cv connective or connective fibres.
d dorsal vessel.
dm dorsal mesoderm.
do dorsal organ.
e ectoderm.
ec edge of carapax.
eo external opening of green gland.
ex extensor muscles of abdomen.
ey eye.
f flexor muscles of abdomen.
fc fibres of cerebral ganglion.
fo fibres of optic ganglion.
g (1–17) ganglia of the primitively postoral series.
ga germinal area.
gc germinal cells.
gg green gland.
gm stomach.
gt gastric teeth.
h entoderm.
ht heart.
I–XX appendages.
i intestine.
l labrum.
li "liver."
m mesoderm (mouth in fig. 11).
me mesentery.
gm mesoderm of green gland.
mn mandibular nerve.
mo mouth.
mu muscle.

n^1	antennular nerve.
n^2	antennal nerve.
n^4	first maxillary nerve.
na	neural blastema.
nc	nerve cells undergoing metamorphosis into nerve fibres.
nc^1	nerve cells of optic ganglion.
oc	ocellus.
oe	œsophagus.
of	fibres of second antennal nerves.
og	optic ganglion.
oi	optic invagination.
ol	optic lobe.
om	ommatidial layer of eye.
os	ostiole of heart.
p	proctodeum.
pf	pyloric fold.
pg	pigment.
py	pyloric portion of stomach.
r	rostrum.
rp	retinophora.
sg	supra-œsophageal ganglion.
sn	Semper's nuclei.
so	somatoplure.
sp	splanchnoplure.
st	stomodeum.
t	thorax (telson in fig. 20).
ta	thoracic abdominal area.
te	telson.
vm	ventral mesoderm.
y	yolk.

Fig. 28. Diagram of egg in "Stage *A*," to show the planes of the sections. By an error, two of the planes are wrongly numbered; the figures 30 and 31 should be transposed.

Fig. 29. Obliquely longitudinal section of stage *A* passing through the anus and through the inner edge of the optic lobe.

Fig. 30. Transverse section of the same stage behind the abdominal flexure.

Fig. 31. Transverse section of the same stage cutting through both nerve bands.

Fig. 32. Diagram of the embryo in stage *C* to show the planes of section of figures 33 to 37 and 41. (The curvature of the lines is due to an attempt to show "great circles" on a plane.)

Fig. 33. Tranverse section passing through the anterior portion of the optic lobes of "stage *C*."

Fig. 34. Same, a little farther back. This and the preceding figure show the separation of the optic and cerebral ganglions.

Fig. 35. Section of same stage, passing behind the mouth and cutting the œsophagus and first appendage.

Fig. 36. Sagittal section of the same stage. (This egg was considerably contracted and the proportions are not quite as in the normal condition.)

Fig. 37. Obliquely longitudinal section of a slightly older stage in which the mesoderm has extended in front of the eye.

Fig. 38. Longitudinal section through stage D.

Fig. 39. "Dorsal organ" of stage *C* (Compare fig. 37).

Fig. 40. Section through the fourth pair of appendages, stage *D*.

Fig. 41. Obliquely longitudinal section of stage *C* (Compare fig. 32).

Fig. 42. Longitudinal section of stage *G* (constructed from two sections).

Fig. 43. Longitudinal section of stage *F*.

Fig. 44. Transverse section through fourth pair of appendages of stage *G*.

Fig. 45. Outline of embryo at stage *G*.

Figs. 46 to 49 are taken from one series, 46 being the 3rd, 47 the 7th, 48 the 8th, and 49 the 13th section, of stage *G*.

Fig. 50. A portion of a longitudinal section of stage *G*, to show the mesoderm extending into the appendages.

Fig. 51. Tip of abdomen at about stage *F* showing the budding cells in mesoderm and ectoderm.

Fig. 52. Section through thorax and tip of abdomen, stage *C*, showing the germ cells.

Fig. 53. A group of ectodermal germ cells from a surface view of stage *C*.

Fig. 54. Longitudinal section of stage *H*, constructed from three sections. The liver (*li*) does not belong in the plane of this section but was introduced to show its position with regard to anterior and posterior ends.

Figs. 55 to 60 and 62 to 63 are taken from one series of an embryo stage *H*.

Fig. 55 is the 5th, 56 the 8th, 57 the 10th, 58 an enlarged portion of fig. 57; 59 the 12th; 60 the 13th, 62 the 15th and 63 the 17th section.

Fig. 61. An enlarged view of the green gland, stage *H*.

Figs. 64 to 69 are from another series of sections of an embryo at stage *H*.

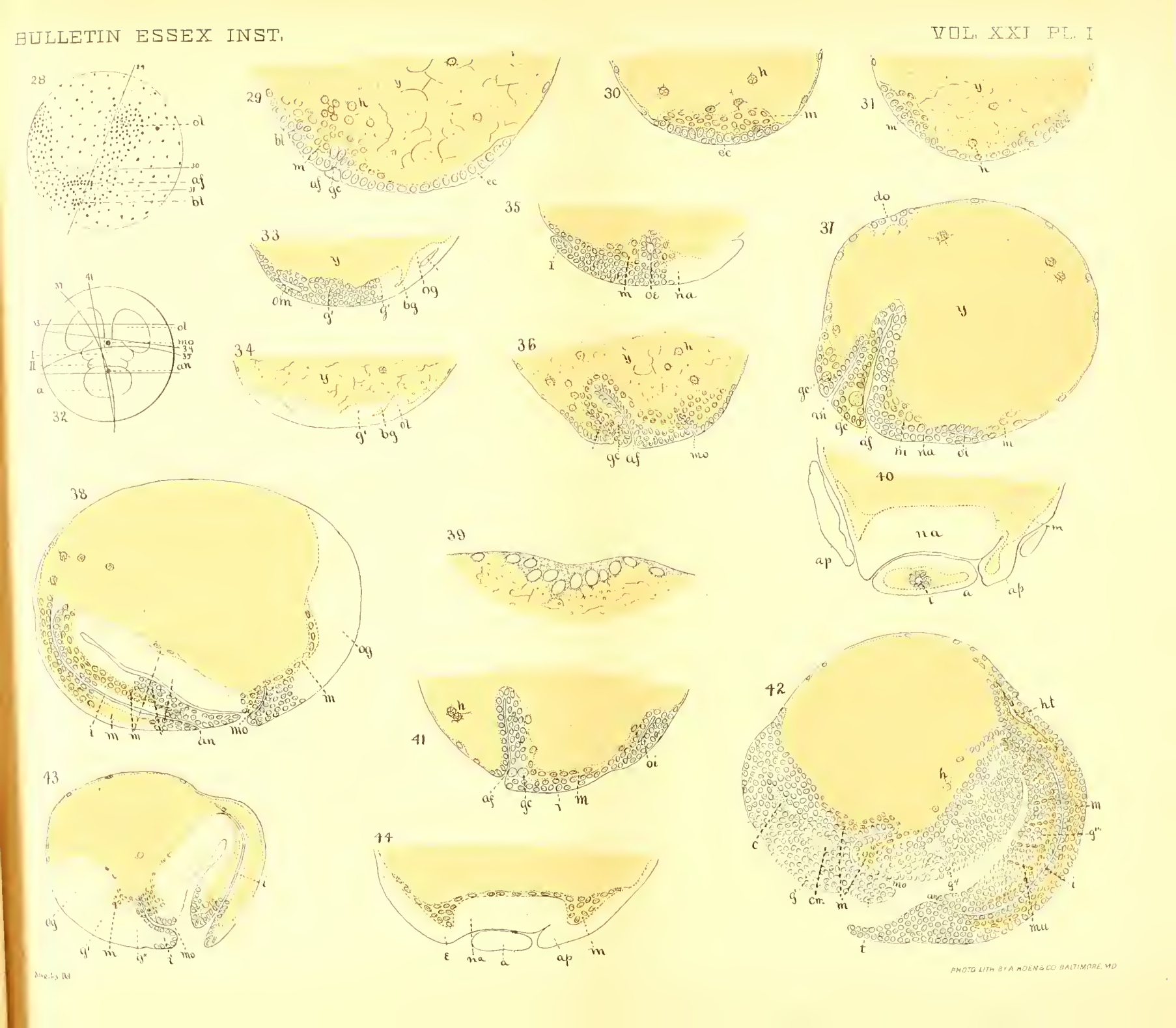
Fig. 64 is the 18th, 65 the 20th, fig. 66 the 22nd, 67 the 24th, 68 the 26th while 69 passes through the abdomen alone.

Fig. 70. An enlarged view of a liver sac at stage *H* showing the amœboid character of the entoderm cells.

Fig. 71. A diagrammatic representation of the relations of nerves and ganglia in the brain at stage *H*.

Figs. 72 and 73. Two longitudinal sections through the head and brain of a free swimming zoea of Crangon.

Fig. 74. Section through the base of the second antenna of a zoea showing (*eo*) the external opening to the green gland. The lumen of the gland did not appear in the section from which the drawing was made.



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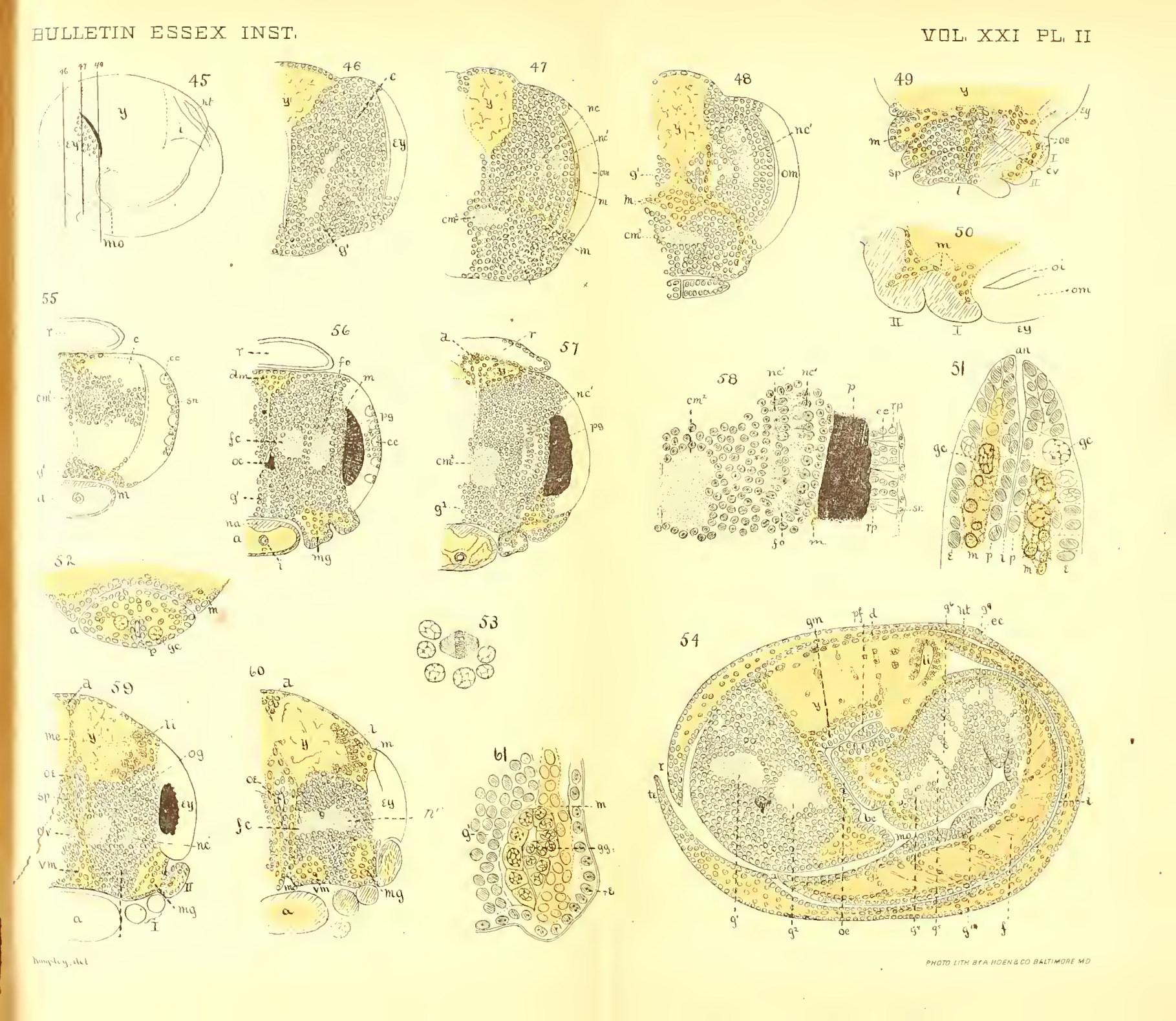
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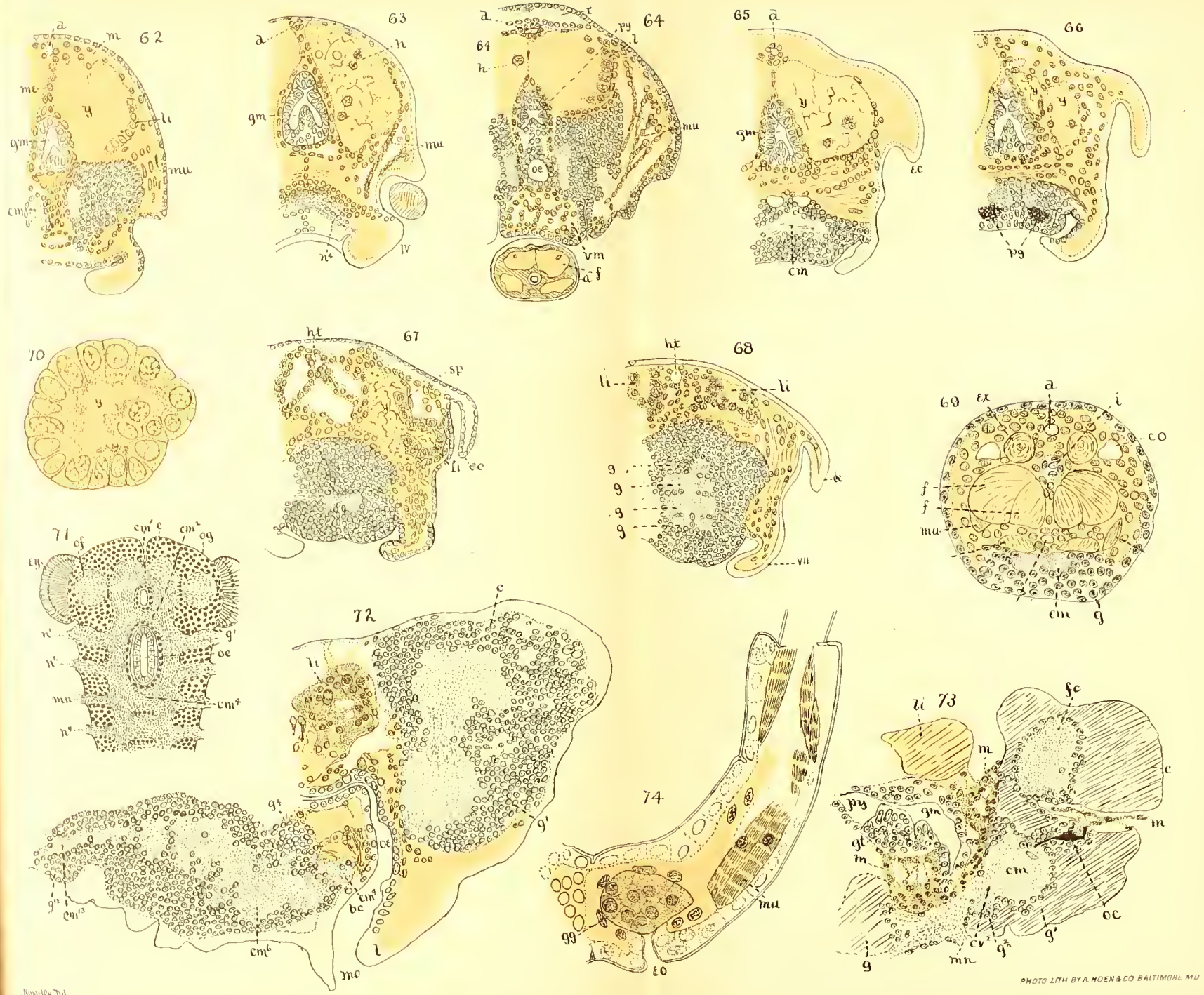

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NEW PHOSPHORESCENT ORGANS IN PORICHTHYS.

BY FREDERICK C. TEST.

(WITH PLATE IV.)

At the suggestion of Dr. D. S. Jordan, the investigations detailed in the following pages were made, under the direction of Dr. J. S. Kingsley, during the year 1888.

Porichthys margaritatus is found on the Pacific coast, where it is generally, if not solely, a shore fish. It has received its common name of "midshipman" from the fact that it is covered with rows of what are described as "shining pores" in Jordan and Gilbert's "Synopsis of North American Fishes." These "shining pores" were supposed to bear some resemblance to the buttons on a midshipman's jacket.

My work was begun, to ascertain the true structure of these "shining pores," and to see if they really were phosphorescent organs, as Dr. Jordan thought they might be. The problem was all the more interesting in that while almost all fishes known to bear phosphorescent organs belong to the abyssal depths of the ocean, this, as I have said, is a shallow-water fish.

The technique pursued was that usually followed in histological researches, serial sections being used, stained *in toto* with alum cochineal. The material on which I worked was unfortunately not in good condition for histological investigations, and only after the plate was engraved, was I

able to obtain sections clearly showing the cellular structure of what I have called the lens. But from the fact that my studies have resulted in ascertaining that the organs are probably phosphorescent in their nature, but differing in many respects from any previously described, I have thought it best to publish them, without waiting for ocular proof of their phosphorescence, or for better specimens.

In Porichthys the organs are arranged in regular lines which follow to a large extent the distribution of the "lateral line organs," and for purposes of description I have given the various rows names by which they will be referred to in the following account.

The two anal(*a*) rows run one along either side of the anal fin, from just behind the vent to the base of the caudal fin. Each row is composed of a double series of organs, these being in pairs, but the outer ones are nearly twice the size of the inner.

The pleural (*pl*) row starts beneath the pectoral fin, runs upward and backward in an arcuate line, and then runs horizontally along the side of the body to a point about opposite the twentieth ray of the anal fin. The organs in this row are single.

The lateral row (*l*) follows the normal lateral line from a point just behind the level of the base of the pectoral to the caudal. It consists of a triple series of organs, the middle of which are the ordinary mucous pores of the lateral line, the lower and upper, however, being phosphorescent organs. The lower series of organs are larger than the upper, which are like those in the row described below as occipital.

The dorsal row(*d*)follows the base of the dorsal fin, and though it is but a single series, it consists of alternating phosphorescent organs and mucous pores.

The occipital rows(*o*) lie on either side of the two dorsal spines. Each row consists of several pairs of organs, each pair with a mucous pore between the two minute organs that compose it.

The frontal rows (*f*) are double, the inner row of either side being about half as long as the outer. In both inner and outer there is that alternation of organs and pores noted above. The curved postorbital row (*po*) runs backward and downward from behind the eye, in front joining the orbitoral(*oo*), running downward from the eye to the angle of the mouth. The angular (*aa*) runs backward from the angle of the mouth. These rows are all short and single.

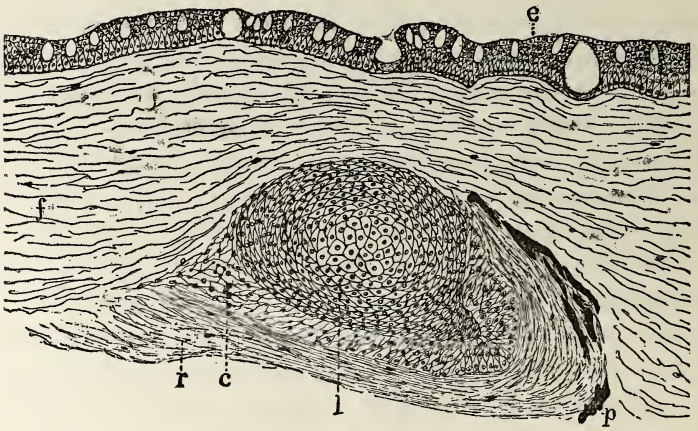
Between the postorbital and the lateral is the curved scapular row (*s*) which in some specimens bends upward toward the dorsal and is then prolonged along the back to form a second dorsal row consisting of phosphorescent organs and mucous pores arranged as in the occipital row.

The opercular rows (*op*), two in number, occur on the operculum, in general parallel to its free margin. The posterior half of the lower row is wholly of mucous pores. The pectoral(*p*)curves around the front side of the base of the pectoral fin joining the gastric(*ga*)below, the latter running back to the level of the anal fin. The mandibular (*md*) follows the curve of the lower jaw. Inside this, and extending back on either side to near the hinder opercular margin is the folded sub-opercular row (*so*), and inside the V thus formed are the two symmetrical gulars (*g*), which run back to the junction of the gastric and pectoral rows. The ventral rows(*v*)form a parenthesis on the stomach, stopping behind on either side of the anus. A short sub-branchial row(*sb*)occurs just outside the base of each ventral fin.

The organs, viewed from the surface, appear as nearly circular shining spots. Sections show that they are con-

tained in the scaleless skin, and are covered by the transparent epidermis. This epidermis is of the regular piscine type common in scaleless forms, with the ordinary mucous cells. The epidermis is not, as might be expected, thinner over the organs. In my first sections, from the poor material, the epidermis had been torn away, and so is not shown in the figures in the plate.

Between the epidermis and the muscular tissues below, is a rather thick layer of fibrous connective tissue. The



Section of organ in pleural row, × 160; *c* = connective tissue capsule; *e* = epidermis; *f* = fibrous connective tissue; *l* = lens; *p* = pigment; *r* = reflector.

organs are entirely embedded in this. An organ consists, primarily, of a more or less spherical "lens," resting on the centre of a circular spicular layer or reflector. This spicular layer is thicker and turned up at the edges, and at one side in some of the organs so far as to form a sort of pocket. It is composed of numberless, almost indistinguishable, spicule-shaped fibres. The "spicules" are not confined to the reflector, but some of them are scattered along in the connective tissue, between the organs. This spicu-

lar reflecting layer is clearly a special modification of the fibrous connective tissue, but its fibres are shorter, straighter and more opaque, and the layer as a whole is more dense than the surrounding tissue.

In both the reflector and connective tissue are occasional scattered nuclei.

That this is a true reflector is readily proved by actual experiment. In sections on the stage of the microscope the spicular layer is markedly fluorescent when viewed by reflected light, retaining its properties after treatment with histological reagents, a fact which is confirmative of the supposed nature of these organs.

The lens is the most prominent part of the organ. It consists of (see cut) a spherical or lenticular aggregation of cells, the central of which are approximately cubical, becoming more and more lenticular or spindle-shaped in section, towards the outside. It is more or less completely enveloped by a connective tissue capsule. (This last was alone preserved, in my first material, the lens having macerated so that no stain would bring out the nuclei, and no sections revealed cell walls in it.)

This connective-tissue capsule in some cases completely envelops the organ, and then again merely forms a cup, shallow or deep, according to the organ. It consists of gelatinous connective tissue, the two ends of cup showing some histological differentiation. A blood-vessel connects with it at the side opposite to the spicular pocket.

In some of the organs, there occurs a layer of pigment below the reflector, while in others all the pigment there is occurs in isolated patches or flakes, at the side of, or below, the reflector. Generally speaking, the organs on the dorsal surface have considerable pigment both beneath and at the sides of the reflector, those on the sides of the body have less, and of those on the ventral surface, some have

but little, and some none. But the amount of pigment, and indeed the development of the organs, varies in the different specimens of the fish examined. In some specimens, the organs, especially on the ventral surface, were plainly not much changed from their original state of slime glands. In the specimen in which the organs were best developed, there were present not only all the organs figured in my plate, but there were additional rows of slime glands (or mucous pores) changing into phosphorescent organs. This was particularly noticeable, first, on the ventral surface; second, in a row of slime glands which had appeared just below the pleural row, and running along with it, a slime gland for each phosphorescent organ; third, in the central slime gland row of the lateral row, where the slime glands were changed into phosphorescent organs; and, fourth, in the organs of the mandibular row, which though in some specimens only slime glands, in this fish possessed lenses, reflectors, and a little pigment.

Indeed, even by examining the small series of specimens of Porichthys contained in the Museum of Indiana University, some twenty fish in all, the evolution of the phosphorescent organs from slime glands is apparent.

In order that the various points of the organs of the different rows may be described and understood, I will designate the "ends" of the organs as anterior and posterior, according to the end of the fish they are nearest. Likewise the "sides" are called dorsal and ventral from their respective proximity to those surfaces of the fish.

Series of sections of the following rows were cut: outer anal, frontal, upper opercular, gastric, pleural, lateral and ventral.

The outer anal organs (fig. 7) are, from a surface view, almost exactly circular. The broad spicular layer is thickest, and slightly turned up at the edges. Thus, it is

cup-shaped, holding in the depression the rather thick connective tissue capsule, on which rests the lens. The portion of the capsule above the lens is thin. The fibrous connective tissue above the lens is rather thick and firm. No pigment is under the centre of the organ, but in the tissue at the sides, and below the edges of the spicular layer, there are a few flakes of it. The spicular layer thins out at the ends, but some few spicules continue to the adjacent organs. At the ventral or inner (nearest the fin) side of the anterior end of the organ, a small blood vessel goes over the edge of the spicular layer to the capsule, from a blood-vessel at that side of, and below, the organ.

Looking at the frontal organs (fig. 3)*in situ*, the spicular layer reflects the light so as to give them the appearance of minute silver dots. The spicular layer is thin, and turned up at the inner (dorsal) side. Above, and lying on the spicular layer, is a mass that corresponds, probably, to the capsule of the outer anal, etc. Embedded in the centre of this mass is a smaller one of about the same shape, which resembles the lens in staining darker than its matrix. No distinct cells can be seen in any part of the mass, nor is there any distinct line of demarcation between it and the fibrous connective tissue. Beneath the reflector is a layer of pigment, and at each side is pigment partly connected with that below. There are several blood-vessels in the fibrous connective tissue, but the exact point of connecting with the organ could not be made out.

In the organs of the upper opercular row (fig. 4) the dorsal side of the spicular layer is turned up, and slightly over, making in this acute angle, a sort of pocket. This pocket is filled up with the connective tissue capsule, which is rather thin above the lens. At the ventral side of the organ, posteriorly, is the nourishing blood-vessel. In contact with the curved portion of the spicular layer, both

above and below, there are several thin, broad patches of pigment. The spicular layer thins out ventrally, but extends a short distance beyond the lens. The ends of the spicular layer are slightly turned up, though not nearly so much so as the dorsal side.

The gastric row has organs (fig. 6) very similar to those of the upper opercular. The spicular layer forms a pocket with the bottom at the dorsal side, and the ends are turned up. But there is not so much material in the capsule, and the lens is flatter. There is no pigment. The fibrous connective tissue over the organ is comparatively thick. The blood-vessel enters at the ventral side.

The pleural organs (fig. 5) resemble the gastric, but the spicular layer does not form so deep a pocket. The spicular layer extends half the width of the organ below it (ventrally). The lens is flatter, and the capsule is thinner on all sides of the lens, than in the gastric organs. There are masses of pigment at the dorsal side of the spicular pocket, and flakes above and below it. The blood-vessel enters at the ventral side.

The large organs of the lateral row, with the exception of having the spicular pocket a little deeper, are similar to the pleural.

The small organs are exactly like the frontal organs.

The ventral organs are like the outer anal, except that the spicular layer forms a little deeper cup, and the fibrous connective tissue over the organ is thicker.

Though sections of them were not cut, yet, judging from the external appearances, it may be safe to conclude that the dorsal and occipital organs are like the frontal, those on the sides of the head like the upper opercular, and those on the throat like the outer anal.

As will be seen by the foregoing, these organs, though varying much among themselves, are formed upon one gen-

eral plan. A lack of literature renders it impossible for me to go into comparisons with previously described types as I could wish.

They but very remotely resemble those described by Ussow[1] in Scopelus, while of all the types described by Dr. von Lendenfeld,[2] they are more nearly related to his "simple, regular ocellar phosphorescent organs with pigment," as will be seen from the following abstract of his description. He says this type consists of "a sac," "about as deep as wide, cylindrical, rounded below, and opening outwards by a circular aperture, which is covered by a continuation of the cuticle." This sac "is formed of a dense layer of pigment," and the "lower proximal part of the sac is occupied by radially placed pyramidal gland-tubes, closely packed, and therefore flattened against each other. Their wide distal ends are rounded and nerves and blood vessels radiate upwards between the tubes." "These tubes are *filled* with spherical or slightly irregular granular cells." "In the centre of the organs within the terminations of the gland-tubes, there is a space, which is filled with a granular secretion. The portion of the organ underlying the cuticle is also granular, but it is easy to perceive that this portion of the glands is occupied by cells."

This type of organ has no spicular reflecting layer whatever, while in Porichthys, the reflector, next to the lens, is the most noticeable part of the organ. In fact the general shape is the only thing they have in common.

EXPLANATION OF PLATE IV.

a = anal row.
aa = angular row.
c = connective tissue capsule.

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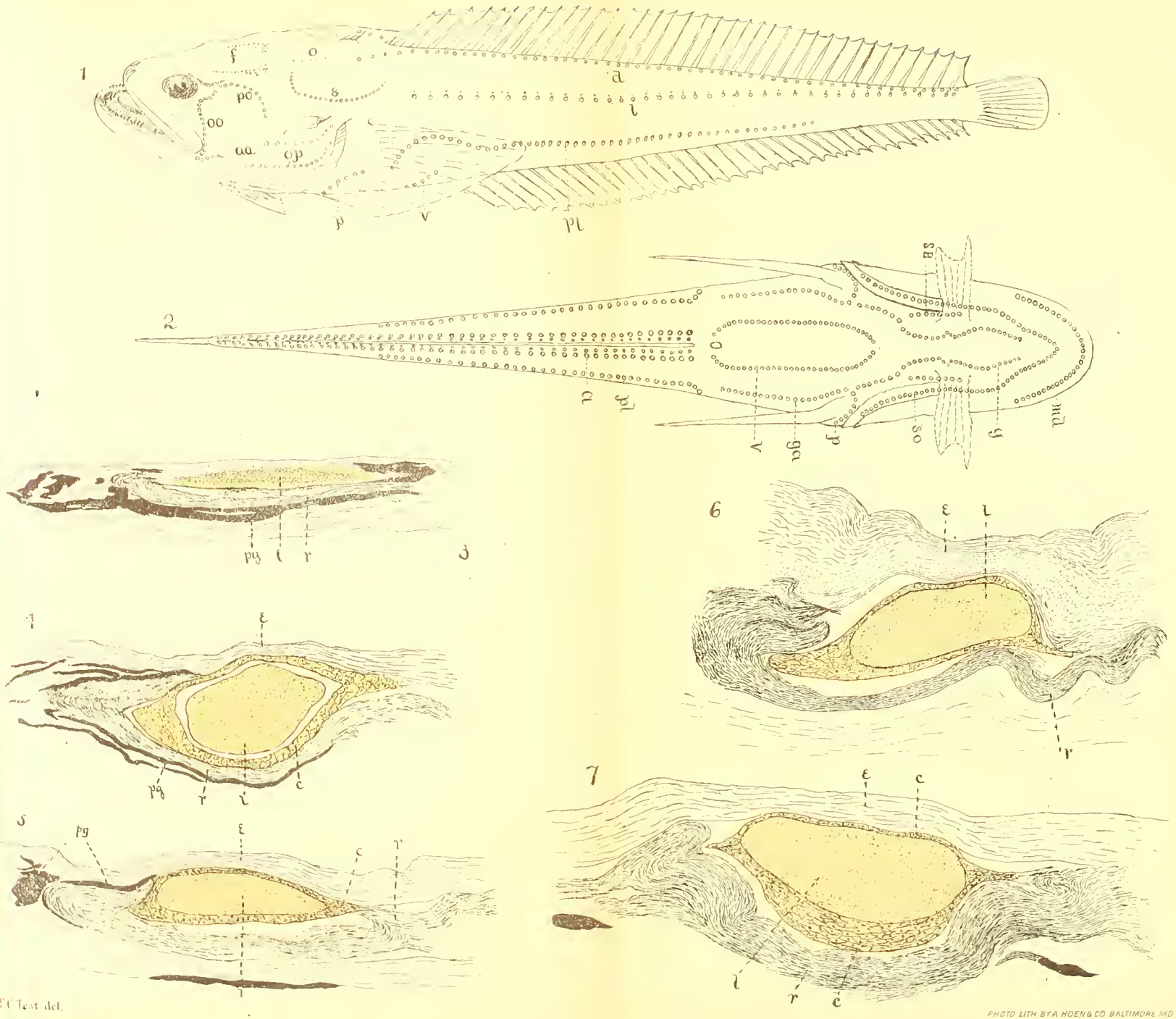
[1]M. Ussow, Ueber den Bau der sogenannten Flecken einiger Knochenfische, Bull. Soc. imp. des. Nat. Moscou, t. LIV, No. 1. p. 79, 1879.

[2]R. von Lendenfeld, Report on the Structure of the Phosphorescent Organs of Fishes, Challenger Reports, Zoology, Vol. XXII, pp. 277-329, plates LXIX-LXXII.

d = dorsal row.
e = fibrous connective tissue.
f = frontal row.
g = gular row.
ga = gastric row.
l in fig. 1 = lateral row; in figs. 3, 4, 5, 6 and 7 = lens.
md = mandibular row.
o = occipital row.
oo = orbitoral row.
op = opercular row.
p = pectoral row.
pg = pigment.
pl = pleural row.
po = postorbital row.
r = reflector.
s = scapular row.
sb = sub-branchial row.
so = sub-opercular rows.
v = ventral row.

FIG. 1.— Left side of Porichthys, showing arrangement of phosphorescent organs. × $\frac{3}{4}$.
FIG. 2.— Ventral view of Porichthys, × $\frac{3}{4}$.
FIG. 3.— Section of frontal organ, × 235.
FIG. 4.— Section of upper opercular organ, × 235.
FIG. 5.— Section of pleural organ, × 235.
FIG. 6.— Section of gastric organ, × 235.
FIG. 7.— Section of outer anal organ, × 235.



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BERLIN: A STUDY OF MUNICIPAL GOVERNMENT IN GERMANY.

BY SYLVESTER BAXTER.

BERLIN has impressed me as the most smoothly running city that I have ever seen. Professor Richard T. Ely, who has made a masterly study of such subjects, declares that it is the best governed city in the world. My own observations were, at the time of my stay in the German capital, more directed towards results: therefore, before proceeding to an examination of the methods which have made these results possible, let me give you a picture, imperfectly outlined though it must be, of the city as it impresses a stranger with its most salient external features.

I must observe, however, that some of these features are the work of the national, rather than the municipal government; but an account of them is appropriate here, as illustrative of German methods.

We are accustomed to look for rapid growth and striking transformations of aspect in our American cities, but we are hardly prepared for similar phenomena in the slower-

paced countries of Europe. I have had opportunities to watch the development of several of our foremost American centres during the past decade, but nowhere have I witnessed mightier changes than those which the German Kaiserstadt has undergone since I previously beheld it in 1877. Then, indeed, it was a city of much magnificence, but it was in the transition state due to its recent assumption of imperial honors, with many defects manifest to the visitor, in the shape of wretched pavements of cobble-stone, a bad drainage system, accompanied by a high death rate, inconvenient methods of local transit, and other reminders of the more provincial days before the great empire sprang into existence. Berlin is one of the most splendid capitals of Europe, hardly surpassed even by Paris in grandeur, and with its population of a million and a half, is the second city of the continent in size and the first in industrial rank. It is growing with the pace of a Chicago, and every year beholds enormous areas of the surrounding sand-plains covered densely with the new houses of the expanding city. Here, in the "sandbox of Germany" amid the barren plains of the old Mark Brandenburg, the cradle of the Hohenzollern might, the tireless energy and persistence of the Prussians have built up the chief city of the most powerful empire of Europe.

Berlin is truly a model city, and should the authorities of any of our great American towns really desire to learn how best to make their municipalities as agreeable and convenient for their inhabitants as possible, I would earnestly counsel them to make a careful study of the great German capital, where everything runs like clockwork, and no one system of public "improvements" is permitted to interfere with the working of any other system. In consequence, every thing is the best of its kind, and the manifold annoyances attendant upon existence in a great city, and which al-

most imperceptibly make a tremendous drain upon the nervous energy of the population, are reduced to a minimum.

We occasionally hear the Germans spoken of as "slow going," but that epithet would better apply to the insular English. There is probably no nation more thoroughly imbued with the spirit of progress than Germany. It is remarkable, the quickness with which the Germans seize upon a great modern invention as soon as its utility has been demonstrated, adapt it to their wants, improve upon it and popularize it by giving it the maximum of cheapness and efficiency. We Americans, fertile in resource and inventive as we are, are too apt to content ourselves with makeshifts, looking too much to cheapness at the expense of real efficiency; we are too ready to experiment upon the public at the cost of its convenience, and the result is often a popular disgust with a valuable improvement that really delays its final adoption. It is therefore at least a question whether Germany does not make fully as rapid progress by her policy of insisting upon having things well and thoroughly done at the start.

The principal streets of Berlin are nearly all paved with asphalt, and they are such marvels of cleanliness and smoothness that one feels the same respect for them as for a nice drawing room, and scruples to litter them even with a scrap of paper. The most frequented ones are literally washed and scrubbed every night; after being wet down a few men or boys proceed along the road, pushing before them pieces of board set diagonally on a pole, with a strip of rubber on the lower side. The mud is thus transferred from the course of one man to another, and finally left in the gutter, whence it is removed. The consequent freedom of the city from dust is very marked. The smoothness of the pavement affords immense relief in diminishing the confusing noise and jar of the streets. Waking early

in the morning at a hotel in the centre of the business section, one perceives no rattling of wagons, only the clatter of the horses' hoofs, so that it seems as if cavalry regiments were continually passing. The smooth streets have also made cycling very popular, and tricycles are extensively used for business purposes. The broad sidewalks are laid with flagging in the centre, and between that and the curbstone are paved with small, mosaic-like stones that form a smooth surface, and are easily removed and replaced. Beneath this space are laid the gas pipes, telegraph and electric light wires, pneumatic tubes, etc., so that in laying or repairing these the street pavement is not disturbed. The wires of the arc lights, as well as of the incandescent, all are carried underground, and in Berlin there are not to be seen the unsightly poles that so disfigure our streets in American cities, where rival corporations are given unlimited license to fight each other and prey upon the public. Only the telephone wires are carried overhead, running over the roofs of the buildings, and these are now being put underground in cables, as far as possible. In consequence of the admirable method pursued there is no interference of one electric system with another; that foe of the telephone service, induction from other wires, is kept at bay, and the patrons of the telephone are not driven frantic by the interference of the clicking of the telegraph or the buzzing of the electric-light dynamos; neither is there the danger of an arc-light wire dropping down and burning out the telephone with its current, setting fires and perhaps killing whoever may be using the telephone at the time; a contingency, which, under our American happy-go-lucky policy, is constantly threatening us.

Our arc-light people have claimed that, owing to the peculiarities of the current, it is impracticable to carry their systems underground, and so they have been free to sus-

pend their murderous wires over our heads, a constant menace, like the sword of Damocles. In Berlin, however, the wires have been carried underground from the start, and no difficulty has been experienced. Instead of adding new ugliness to the streets, the arc-lights of Berlin are things of beauty, an artistic embellishment to the city. Unter den Linden is probably the most brilliantly and beautifully illuminated street in the world. Along each side and down the centre, where there is a double row of trees similar to Commonwealth avenue in Boston, the arc-lights are set even more closely together than ordinary gas lamps, and the effect at night is that of great strings of white, gleaming pearls. The posts consist of graceful iron standards, with tasteful ornamentation and curving over at the top. Here the globe is suspended, inclosed in a coarse network, so that, in case it breaks, the pieces of glass may not fall on passers. From the globe there hangs a light chain, with a ring in the end, and there are counterbalancing weights inside the post, so that the lamp is quickly and easily attended to by pulling it down with a light stick, with a hook in the end — a great improvement, in the economy of time and trouble, over our clumsy methods of either climbing the post or lowering the light by an unwieldy and ugly crane.

The incandescent light is very extensively used. It illuminates all the first class theatres, halls, hotels, and many stores and private houses.

The telephone-service is admirable, as is testified by the public appreciation, there being over 10,000 instruments in use in Berlin. There are no private telephone companies in Germany, the telephone, like the telegraph, being a branch of the postal-service. The price for telephone service is low, the annual charge for an instrument being one hundred and twenty marks a year, or something less

than thirty dollars. The long-distance service between the principal cities of the empire is being rapidly introduced. By reason of the telephone being a part of the postal-service, patrons are afforded conveniences beyond those enjoyed by us in the land where the Bell Telephone Company is earning profits of 30 per cent. annually. A telegram received for a person who has a telephone is at once delivered orally from the central office, and the written message then forwarded by the local post. Likewise a telegram is transmitted by the sender to the telegraph office by telephone. The telephones in use are manufactured by Siemens & Halske, the great electricians, and are said to be a great improvement upon the Bell patent, upon which they are based.

The efficiency of the German postal-service, with its branches of telegraph, telephone, pneumatic tube and parcel post, is a sufficient reply to the assertions that the convenience of the public cannot be so well met as by private corporations having control of the various means of intercourse. Postmaster General Stefan is always on the lookout for opportunities for improvement, and is quick to seize upon any new means afforded by modern inventions for increasing the efficiency of the service. The Imperial Postal Museum in Berlin is a most interesting place to visit. Here can be seen models of all the various devices used in the service, as well as a valuable historical collection illustrating postal intercourse from the earliest times. Postal administration is regarded in Germany as a practical science in itself, and no means is neglected to promote the interest of members of the service in its study. At the postal museum there is one of Edison's original phonographs, and a high official of the service told me that the department was anxious to secure one of the improved ones at the earliest possible moment, in order to see what use

might be made of it in the department, and we may be sure that, if a good use is found for it, it will be put into application without delay. The pneumatic-tube service of the Berlin post-office, for the quick delivery of letters, etc., is a great improvement upon our special delivery system. The pneumatic lines radiate out over the city from a central station, connecting various local stations at frequent intervals, so that a message is delivered in almost any part of the great city within half an hour. The postage for the pneumatic service is 25 pfennige, or 6¼ cents. Telegrams are very extensively sent and delivered by means of the pneumatic service.

Now contrast the efficiency of the German post-office with its widely comprehensive functions, with the condition of things in the United States, where, indeed, the postoffice itself, pure and simple, is reasonably efficient, considering our slipshod and barbarous civil-service system, but where the public is at the mercy of two great and greedy monopolies for the telegraph and telephone service, which have become as essentially a part of public intercourse as the carrying of the mails, and are just as properly a legitimate function of the government; as Germany wisely recognizes. It must eventually be perceived in the United States that the only remedy for the extortionate and inefficient telegraph-service to which the public is now subject is the government administration thereof, although when Congress is "influenced" by the Western Union Company with free telegraphic passes, as Senator Ingalls unintentionally confessed a few months ago, it is probable that only an overwhelming public pressure can effect the change. The despotism of a plutocracy is becoming a serious danger in the United States.

A like increased efficiency of service has followed the resumption of the control of the railways by the Prussian

government. A prominent business man of Berlin told me that he had originally been strongly opposed to government ownership of the railways, but he now saw that it was the best thing that could have happened. The public convenience had been vastly increased by better and more frequent train service, cheaper rates, and the avoidance of the ruinous competition of private corporations, while every diminution of the evils of stock gambling, such as was occasioned by the withdrawal of the railway element from the market, was a direct benefit to legitimate business and the public at large.

In the great cities the stations are mostly on a grand scale and of beautiful architectural design, expressing the character of the building. In England, under private control, the railway stations are almost universally mere sheds, differing only in magnitude, with hardly a rudiment of artistic design, and little attention paid to the comfort of passengers, while their sides are so plastered with advertising that, when a train stops at a way-station, it is with great difficulty that a stranger can detect the name of the place.

The Stadtbahn, or city railway, in Berlin is a great convenience. It is an elevated railway traversing the city from east to west, and connecting with the Ringbahn, or belt railway, that surrounds the city. Both belong to the Prussian government, and are of great military value, enabling the saving of two or three days in the mobilization of troops and their rapid transportation through the city in case of need. The Stadtbahn is built upon substantial brick arches throughout its length, and, instead of occupying the streets at the expense of the abuttors, as in New York, the right of way was purchased for it, and the buildings were demolished to make way for it. The stations are elaborate and handsome affairs, with arching roofs sim-

ilar to the Lowell stations in Boston. There are four tracks, two for local and two for through traffic, and all express trains from distant cities are brought into one grand central station at the Friedrichstrasse, in the heart of the city. The hackman nuisance, common to our railway terminal, is obviated by having an official stationed at the exits from the station, from whom passengers receive a check for a cab, finding the corresponding number waiting on the street. The railway also provides porters to take out and bring in the baggage, receiving a moderate and stated fee for their service.

The street-railway system of Berlin is excellent. It is all in the hands of one great company, as in Boston, and the cars thread the streets in every direction, gliding smoothly and rapidly over rails grooved in the centre and jointed diagonally, offering no obstacle to the traffic of wagons and carriages. The cars only stop at stated points, indicated by a little sign at the edge of the sidewalk. The movement of cars is thus materially accelerated, and so accustomed is the public to this arrangement that even ladies who wish to get off at a point where the car does not stop often skip lightly off while it is in motion. There is also an omnibus company doing a large business. Many of its vehicles are very similar to street cars in construction, with large platforms behind, and with wheels hardly larger than those of the cars. They move more smoothly over the asphalt.

Berlin has an admirable park system, with which the art of the landscape gardener has done wonders in creating beautiful passages of woodland and meadow, charming contrasts of tree and shrubbery groupings with intervening glades, out of the monotonous flat country amid which lies the German capital. There are four great parks around Berlin, and a fifth of lesser size, the Victoria Park, named

in honor of the Empress Friedrich, has recently been begun. Beautiful rural scenery is thus brought within convenient distance of nearly all parts of the city. The Thiergarten, composed principally of a noble old forest, has been greatly improved within the past few years, and is now one of the finest parks of Europe. The other great parks are the Friedrichshain, the Humboldthain and the Teltower Anlagen. The latter runs along the Spree for several kilometers to the northeastward of the city, and shows what charming landscape effects can be wrought in a perfectly flat region. The Humboldthain, being situated where the river bottom in which the greater part of Berlin is built rises to the surrounding upland plain, has the advantage of ground that is diversified by graceful undulations. The park was named in honor of Wilhelm von Humboldt, and contains a simple and beautiful monument to the memory of the great naturalist—only a heap of naturally disposed boulders, amidst a clump of shrubbery, and overgrown with ferns and moss. From beneath a stone, simply inscribed to the effect that the monument was erected by the city of Berlin to the memory of her distinguished son, there trickles a pretty little rill of clear water that runs merrily through the bushes down the slope into a calm pool.

Throughout the city nearly all the open places are occupied by beautiful gardens, arranged with charming grace and simplicity, the effect depending more upon harmonious groupings of shrubbery and graceful trailing of clambering vines than upon elaborate flower beds. These urban gardens are extensively used for children's playgrounds, and here and there are placed great heaps of sand upon the broad walks in which swarms of little ones may be seen digging and burrowing all the day to their heart's content.

The form of the municipal government of Berlin is, in general, that prevailing throughout Prussia, as determined by the municipal reform laws created by the great statesmen Stein and Hardenberg in 1808: the laws which have given a general model for the forms of municipal government now prevailing throughout the German Empire.

The growth of cities in Germany dates back to the early Middle Ages, when the country gradually took on the modes of civilization. The cities grew up out of the original Roman colonies and from the populations clustered about the castles of the local rulers. Trading points and market places also grew in importance, and assumed the shape of cities.

In the Middle Ages there were, in general, three great classes comprising, respectively, the powerful nobility, the dwellers in the towns, and the agricultural population. The cities became so powerful as to hold rank with the nobility, between whom and the landed population bitter conflicts often arose. This state of things is pictured in an old German student's song which compares the entire population to a glass of beer, the nobility being the foam, the burgesses the substantial liquid, and the much oppressed peasantry the dregs. When the peasantry found themselves too hardly treated by the nobility, they often fled to the cities, and appealed to the latter for protection. Sometimes they could not be received within the city, for the lack of room, or other reasons, and were allowed to settle outside of the walls, where they enjoyed the protection of the city, but were not privileged with the full rights of those dwelling within the walls. In this way were developed the various classes into which the city population was divided: the patricians, the various trade-guilds and the ultra-mural population. The cities, as they grew in power, recognized the advantages that would come from

united action, and in Germany, in and after the Interregnum, from 1254 to 1272, there were organized three great confederations: that of the Rhine, the famous Hanseatic league, and the great confederacy of Suabian cities, extending from the foot of the Alps to the mouth of the river Main. Cities, at this period, grew so in power that they obtained representation in the governments throughout Europe, and, with their great wealth and prosperity, they became the parents of modern civilization. In them there first was developed the modern republican form of government, and in Germany the numerous free cities became integral parts of the empire, on a par with the princely states, and owing allegiance only to the Emperor. Of these, since the annexation of Frankfort by Prussia, in 1866, there now only remain Hamburg, Bremen and Lübeck. These three "free cities" are living examples of the way in which cities formerly exercised a domain over considerable tracts of territory frequently not adjacent, but often lying at some distance with lands of other states intervening and are, in reality, Republican states in the present Empire.

The mediæval forms of municipal government survived, to some extent, down to the Reforms of 1808, when a complete reorganization took place. This reform system has only been modified to adapt itself to the changed condition of suffrage, etc., prevailing to-day. In it is exhibited the working of the German ideas of self-government by the people, which, in the cities, have been exemplified to the fullest extent.

While throughout the Empire universal manhood suffrage prevails, in the city governments the suffrage is slightly restricted. Every honest inhabitant obtains the electoral franchise after a year's residence and at the age of twenty-four, if he pays what is called a class tax on an income of about one hundred and fifty dollars. These restrictions

make the qualified voters in Berlin about thirteen per cent less in number at municipal elections than in the national elections.

In the government of Berlin, we have the spectacle of one of the greatest cities of the world administered with the utmost economy and efficiency, attaining the most splendid results for the comfort and convenience of the public, without the suspicion of jobbery, and everything attended to with the thoroughness and conscientiousness which here we are only accustomed to expect in private enterprises. Professor Ely praises the open conduct of the government, with its reports submitted with the greatest of detailed clearness, rendering the accounts to the last penny, and with the motives and plans of the officials completely described. In reading one of these reports he remarks that "one finds it difficult not to believe it a description of some city government in Utopia."

Public spirit is also nourished into a splendid growth by this system. Over ten thousand citizens take part in the administration of affairs, and, in the city government, one looks for the best and most prominent citizens among the members, and not the worst, — and finds them, too. For example: there are men like Professor Virchow, Professor Gneist, and others from the University, and natural leaders in public life; men of world-wide reputation and ranking as statesmen, taking their regular part in the routine of city affairs. Professor Gneist has been a member of the city government since 1848. To shirk these responsibilities is hardly possible for any man, even if it were desired by him, for every citizen is obliged, under penalty of a fine and a heavy increase of taxation, to accept any position to which he may be elected.

The Berlin system aims at the greatest efficiency and economy attainable under a fundamentally popular repre-

sentative form. The broad basis of the government is to be found in the Municipal Assembly, a body composed of one hundred and twenty-six members, representing the three hundred and twenty-six wards of the city. One-half at least must be house-owners; and two brothers, or father and son, are not allowed to be members at the same time. The members of this body are chosen for six years, one-third retiring every two years, so that there is a municipal election once in two years. This gives the great desideratum of permanency, a principle which is embodied firmly throughout the entire municipal structure. As with a physical organism in its process of growth, the changes in a German city government are gradual, not violent. The example set by nature is wisely followed. The long terms of members give them experience, and the remaining in office of a large majority of old members assures the management of affairs by persons thoroughly conversant with municipal business. This Assembly directly represents the people, and out of it proceed all the other features of the municipal government. It has the entire financial control of affairs, being supreme in drawing up the budget for the year, and in authorizing extraordinary expenditures. It has no executive functions as a body, but its members exercise them individually in association with other branches of the government.

This Assembly chooses the upper branch of the city government, known as the Magistracy, and composed of the Board of Mayor and Aldermen, the latter thirty-two in number, fifteen of whom are salaried, while seventeen are honorary members with no salaries whatever. The Mayor is chosen for a period of twelve years, nominally subject to the approval of the king. His salary is thirty thousand marks, equal to about seventy-five hundred dollars, which, in its purchasing value in Germany, would probably be

substantially the same as the ten thousand dollars paid to our Mayor here in Boston. It is a post of the highest honor, and may be considered equivalent to a life position, for when there is a vacancy in this office in a large German city it is customary for the authorities to survey the field throughout the country, and select from the mayors of other cities some man of the highest qualifications for executive and general business efficiency; and the person thus agreed upon can usually make his own conditions and be sure of reëlection when his term expires, if he does not choose to retire upon a liberal pension. One mayor of Berlin, when chosen, refused to accept the position unless certain objectional state laws were repealed, and the government was prevailed upon by the city authorities to take such action. The present mayor of Berlin, von Forckenbeck, was mayor of the large city of Breslau when called to Berlin. The mayor has general direction of the Board of Aldermen, and is almost absolute in the disposal of city business.

The fifteen salaried aldermen are elected for twelve years by the municipal counsel, with especial regard to the qualifications for administering the departments over which they are to rule. Their salaries being higher than those of the local judges and the higher members of the Civil Service, the offices are made attractive to the best class of men, who must have received a thorough training in the splendid civil service of Prussia from which they were chosen. It is also the custom to re-elect these men on the expiration of their terms, if they do not choose to retire on their pensions. These paid aldermen consist of the deputy mayor, two legal advisers, the city treasurer, two school councillors, two architects, and seven aldermen without special title who may be assigned to any positions they are deemed most fit to occupy. These men correspond to the heads

of our various department commissions, but it is a great advantage to have them regular members of the Board of Aldermen, where they may take part in the deliberations.

The seventeen unpaid aldermen are chosen by the Assembly for terms of six years, are usually taken from the higher class of citizens and, indeed, from those members of the Assembly itself, who have distinguished themselves by years of efficient service in various departments. Their positions are esteemed of great honor, and the incumbents assume the same duties as those of the paid aldermen. They are also usually reëlected at the end of their term, so that any competent man may be a member of the city government for life, if he chooses; and under this system it would be difficult for an incompetent member to be elected. Professor Gneist, in his admirable paper contributed to the Contemporary Review five years ago, and to which I am largely indebted for the details of this effort, as well as to the kind suggestions of Professor Woodrow Wilson of Wesleyan and Professor Ely, calls this Board of Aldermen "the soul of the government of the city," and points out that its ability to control the wide range of important interests of so large a community is due to the excellent division of labor which has gradually developed itself in the management of the business.

Returning to the municipal assembly, I must describe the peculiar manner in which it is chosen by the people. The voters of the city are divided into three classes, a system which prevails throughout Prussia, and, I believe, throughout Germany. These classes are divided according to the rate of taxes they pay. In the first class come those heaviest tax-payers who pay one-third of the entire levy. In the second class come those who pay the next third: while the third class comprises all the rest of the tax-payers. Each of these classes chooses one-third of the

assemblymen who are to be voted for at an election. In consequence a majority of the assembly is chosen by a minority of the voters; the principle prevailing in municipal suffrage in Germany being similar to that in a financial corporation, where voters exercise a power corresponding to that of the number of shares they hold. At a recent election the number of voters in the first class was a little over three thousand; in the second class a little less than sixteen thousand, while the small tax-payers, in the third class, numbered over one hundred and sixty-six thousand. It is usually the case in a German election in the large cities that the first and second-class vote is either "liberal" or "progressive," while the third-class vote manifests conservative, radical and socialistic tendencies.

The two chambers are supplemented by a body of seventy "citizen deputies," as they are called, selected by the Assembly from distinguished citizens to serve on general committees for the administration of special affairs, such as the relief of the poor, the conduct of the schools, etc. At the head of these committees an alderman acts as chairman, and other aldermen may be leading members; and members of the assembly, together with the citizen deputies, form the rest of the membership. Under this executive staff of two hundred and thirty members, composed of aldermen, assemblymen and citizen deputies—nearly all honorary officials are men of independent means who can afford to give their time to the city—there is a large staff of paid officials who are appointed for life, as is the rule in the German Civil Service. This system of life-appointment combines efficiency with cheapness, for a man is naturally willing to serve for a lower salary when assured of employment for life. Salaries are also increased with increase of efficiency, and the first few years of official service are probationary.

With the administration of justice the magistracy has considerable to do, and jury-lists are made up in a manner similar to that prevailing in our city governments. Minor criminal cases are tried, not by jury, but by a court consisting of the local judge, aided by two citizens drawn from the jury-list, who have a full and equal vote with the judge. The arbitrators for that useful institution, the Courts of Arbitration, are also selected by the magistracy. As assistants to the courts in the guardianship of orphans, etc., small committees are selected for service in the various wards, comprising one hundred and seventy-one chairmen, six hundred and thirty-six citizens, and some hundred ladies.

In Berlin, and some other large cities, the police is administered by the State instead of the city. The force consists of something like three thousand men, besides their officers; and the expense, amounting to nearly four hundred thousand dollars annually, is borne by the city. Certain branches of the police, not concerned in the preservation of the peace but in the general public welfare, are administered by the city; such as looking after the trade societies, benevolent institutions, etc., as well as sanitary matters, and the construction of streets, etc.

The great transformation in the appearance of the streets in Berlin, which has taken place within the past fourteen years, is due to a change of administration from the State to the city. The State, up to 1874, had the maintenance of the Berlin streets in charge, and was reluctant to grant sufficient appropriations for the purpose; therefore visitors were astonished at the wretched condition of the pavements, sewers, bridges, etc. Now, however, since the city has assumed the work, it has been carried on with magnificent enterprise and energy, resulting in the perfect pavements, beautiful new bridges, fine public carriages,

the best street-railway system in Europe, an excellent water-supply, and the gigantic sewerage-system, that now go so far to give Berlin its character.

The system of taxation comprises an income-tax of three per cent. on all incomes above a certain amount; a house-and-rent-tax, apportioned between the landlord and the tenant; and various minor special taxes.

The relief of the poor is performed by two hundred and twenty-three local commissions, each composed of between four and twelve citizens, or honorary members, with the assemblyman of the district as member *ex officio*. Something like sixteen hundred citizens take part in this work, and the methods employed are directed towards assisting the worthy poor people without the imposition of degrading conditions. One feature is the assignment of certain city lands to the poor, for planting with potatoes. Only vagabonds and altogether unworthy persons are sent to the workhouse. The charitable institutions of the city are numerous and well conducted. The relief of the poor, in 1881–1882, cost over one million one hundred thousand dollars. This system probably accounts for the marked absence of evidences of distressing poverty. The contrast between Berlin and London, in this respect, with the brutality, crime, degradation and misery of the latter city, is almost as marked as that between Paradise and the Inferno. The fire brigade of Berlin is a military organization with seven hundred and fifty men, besides officers, and was maintained in 1882 at a cost of about three hundred and seventy thousand dollars. The cleaning of the streets is admirably done. It always takes place between midnight and eight o'clock in the morning, a marked contrast to the methods prevailing with us, where we frequently see a street-sweeping machine operating at mid-day, filling the air with filthy dust, to the annoyance of multitudes. Dirt, snow

and ice are promptly removed, and the sidewalks, as well as the roadways, are thoroughly cleaned by the city. The cost of the paving is very considerably diminished by the street-railway company, which, by its concession, is obliged to pave the whole of the streets through which its tracks pass with the best of pavement, besides paying a certain percentage of its receipts to the city. This source of revenue for the municipality now amounts to something like two hundred and fifty thousand dollars a year, besides having a large proportion of its streets paved without expense to itself, and, in 1911, the street-railway with its entire equipment becomes the property of the city.

The municipal gas-works yielded, at last accounts, something like eighteen per cent. of the entire annual expenditure of the city as profit.

The water-works, also, yield an annual profit of considerably over a quarter of a million dollars; and even the great sewerage system has produced a net revenue of something like the same figure, through the annual rate imposed upon house-owners for the use of sewers.

The school system of Berlin is one of the prides of the city. It is controlled by a school-board composed of members of the city government, superintendents of the church-dioceses together with the dean of the Catholic churches, and eighty-seven local committees, upon which something like thirteen hundred citizens serve. There were, in 1881, one hundred and eighteen large common schools, attended by rich and poor alike, with one hundred and forty-two head masters, fourteen hundred and seventy-one male teachers, seven hundred and thirty-four school mistresses and five hundred and fifteen technical instructors. There are, besides, ten gymnasiums, corresponding to our Latin schools, seven real-schools, corresponding to our English high-schools, two industrial schools and four high-schools

for girls; all very largely attended, besides six State schools, comprising four gymnasiums, one real-school and one high-school for girls. Another important class of schools, die Fortbildungsschulen, or supplementary schools, was founded by the city to enable apprentices and clerks to continue their studies. There are twelve schools of this kind. There are also Sunday classes for young people of both sexes, maintained chiefly by private subscription. Every school building has a gymnasium, large and well equipped, for athletic instruction; and besides, there is a Turn Halle, a great and model institution for athletic training; also something like ninety private schools, that find it more and more difficult to compete with the public schools, so excellent are the latter. These private schools are also under the supervision of the public school authorities, and must conform to public standards; there are also twenty-two public libraries, mostly in the charge of the head masters, for sending out instructive books, free of charge.

The net debt of the city is but little over four million dollars, a decrease of nearly two million since 1876. This is a contrast to New York, whose net debt is over one hundred million dollars, and Boston with a net debt of something like twenty-five million dollars.

Owing to the excellent condition of the finances, Berlin has founded a number of institutions of credit on the security of the wealth of the city. One is a municipal savings bank, with deposits now amounting to something between twelve and thirteen million dollars, with thirty-nine offices for receiving deposits in various parts of the town. It pays an interest of three and one-third per cent. There is also a municipal fire insurance office, in which all the house-owners are obliged to insure. In 1882, the value of buildings insured was over five hundred million

dollars and since that time has enormously increased. Owing to the substantial construction of the city and the excellent fire-department, the annual premium is only five or six cents on a hundred dollars. Another city institution is a mortgage bank, established in the interest of the credit of real estate, issuing on varying terms mortgages at four, four and one-half and five per cent.

A striking fact in connection with the Berlin city government is its effect upon party feeling among its members. While considerations of party govern, to some extent, in the elections, Professor Gneist assures us that "the party element soon gets smoothed in the intimate deliberations of the board of aldermen, in the great committees and in the numerous committees of wards. These animosities of party get gradually blurred and finally blotted out altogether in the common toil of daily work for the interests of the community. The results of this activity teach every day that it has been the aim and object of the *communitates* to smooth down and to obliterate social hostility."

We have found the city government of Berlin forming a large and compact organization, its various functions closely interrelated at the nucleus and ramifying out, like the rays of crystallization in a chemical solution, into the great mass of common citizenship. We have seen that its result is an almost ideal business-like management of affairs, with economy and efficiency combined, resting upon a self-government most thoroughly republican and promoting public spirit among the most influential citizens.

We have the example: now as to its application. All systems of government are but expedients of time and place, and that form is the best which produces the best results. A candid examination of our American systems will show that, on the whole, they fall far behind the

standard of efficiency that should prevail. We see too often the worst men in charge, and the best citizens either totally repelled by the character of the associations prevailing in our city halls, or only spasmodically aroused to take a share in the management of local affairs; and when they do come forward they are apt to find themselves hopelessly handicapped in their efforts by the radical defects of the system and the numerous adverse influences prevailing around them. We see the spirit of sectionalism dominating the councils of the city, and the system of government operating to encourage the men representing the different localities in combining to "log-roll" extravagant measures into operation, for the gratification of their constituencies and to the injury of the community as a whole. This curse of sectionalism, so discouraging to public spirit and giving evil character to our entire political structure — from the councils of our nation down to the wards and precincts in our cities—has of late been on the increase. In our own city government of Boston it has been extended, through legislative action, for the sake of political results, and it forms a most undesirable feature of nearly all the municipal governments in Massachusetts. As to our Massachusetts cities in general, there is too great a diversity of form. The varieties of city charters existing have something of the appearance of experimental samples. Some cities have powers which other cities have not. There is no ground for showing favoritism to localities any more than to individuals, and the plea of "peculiar local needs" in excuse for these differences is a specious one. There is no reason why any one city should have different rights or privileges from those enjoyed by another. Our cities in Massachusetts have now become so numerous that the legislature might do well to provide for a special commission to study the ques-

tion of municipal government and report upon some uniform system for the administration of all the cities in the Commonwealth, making extra provisions, however, for the needs of a great city like Boston.

In thus setting forth the excellences of the Berlin systems, I would not, by any means, urge that it be copied here; but I would suggest that some of its admirable fundamental principles might be adopted to excellent advantage. I know that when a foreign model is held up it is customary to raise against it the cry of "un-American" and to point to the necessity of preserving "the time-honored structure" of our existing forms. But surely the securing of the most efficient method of local self-government cannot be "un-American," and neither should a system that promotes public spirit, economy and honesty, and makes rings, jobs and bosses impossible.

As to the "sacredness" and "time-honoredness" of existing forms it is sufficient to point out that our two-board system is but a clumsy and distorted imitation of the British parliament, and that city governments have hardly existed long enough yet, in this country, for their forms to become "time-honored."

In the first place, I would say that the three-class system of restricted suffrage prevailing in German municipalities, well as it works there, would be undesirable here, even if it were practicable, as it is wholly out of conformity with our American principles. We often hear some of our men of large property urge that we ought to have something of the kind here, but they are wasting their breath, and it is useless even to think of it. If they would but bend their energies towards achieving what is practicable they would do well.

It would be desirable, however, by all means, to accept the example of the German Municipal Assembly and, in-

stead of abolishing the common council and adopting the one-board idea which just now appears to be the popular panacea for municipal ills, make the common council the basis of the whole city government. Then incorporate the splendid principle of permanency into our system, by giving the members long terms and thus obtaining men of experience, and provide that but a third of the members shall retire at each election. In this way, while preserving the principle of sectional representation, we should be rid of its baneful effects. Let the common council elect the mayor and the aldermen for long terms and make the heads of departments members of the board of aldermen. Give the mayor unrestricted executive powers. It is wise to have the executive officers elected by a representative assembly instead of by direct popular vote, for experience has taught us that, in the nature of things, masses of people are incompetent to decide upon the real qualifications of men for positions of responsibility. When elections hinge upon persons instead of principles, personal considerations are liable to prevail in deciding the issue; measures being simply used as expedients for placing certain persons in power, instead of persons being advocated for the sake of measures.

Berlin sets us a grand and highly important example in another respect which it would be well to follow and, indeed, improve upon. It may be laid down as a broad principle, that whatever men can do better by combined action than by working as individuals, that thing they should do, through the instrumentality of their governmental organizations both for considerations of economy and for the greater good resulting in broadening and improving individual character through working in unison with others for the good of all, than alone, simply, for the good of self. This principle holds good both in national

and local affairs. It is to-day practised, both nationally and locally, to a limited but steadily increasing extent. Its scope should be extended, and the principle applied wherever possible. Nothing but good can come of it.

We have seen how admirably Berlin manages its gas and water works; how its street-railway system yields a handsome revenue to the city and will ultimately become wholly public property. Let us do likewise. Let us do with our gas and electric-light works, for instance, what we have always done with our water works. Boston could well afford to purchase the property of the several gas companies, even at the present high value of the stock, and by supplying cheap fuel, as well as light, to the public, at rates otherwise impossible on account of the dividends that must be earned on large capitalization, she would confer an inestimable benefit upon the people, as well as obtain, if desired, a grand source of revenue; another consideration would be the business and the population which would be attracted to the city through the conveniences of the cheap fuel that may now be obtained from gas.

Then let the city take the electric-light supply in hand. The present companies with their conflicting interests must ultimately unite, and then the public will have to pay rates large enough to yield profits upon the great consolidated and unnecessary capital. This is needless and it will be folly to permit it. Numerous examples exist to demonstrate how much cheaper a city can conduct such a business for the public than can any private corporation. Moreover, our streets and buildings are now disfigured with wires and poles, and lives and property are continually in danger from the defective methods now prevailing. With the city in charge, how speedily these things might be straightened out! (See Appendix A.)

It should also be borne in mind that the baneful influences of corporations, in the lobbies of the national capitol, of state houses and of city halls alike, with their great schemes to be promoted, constitute one of the most perilous menaces to our American principle of free government. Let the people take things in charge for themselves. Let them exercise these functions in their own behalf, through the instrumentality of their governmental organizations. Let us first take hold here, nearest at hand, through such a municipal government as we need and can have, if we will.

APPENDIX.

A. MUNICIPAL MONOPOLIES OF SERVICE.

I specify the matters of gas and electric light because they happen to be the things nearest at hand and the question of the assumption of the business by the city of Boston is now under discussion at the City Hall. To do this will be wise and profitable; not to do it will be short-sighted folly. How to do it best is something that the intelligent consideration of our most practical men ought to show. But, inasmuch as our new gas monopoly has reached its hands out into the suburbs on all sides, and as the interests of the surrounding municipalities are so thoroughly bound up with those of Boston in the matter of street railways, highways, sewerage and other things, it seems as if these subjects might be best and most economically handled by constituting a metropolitan district—a greater Boston—for their administration in the interests of the whole with an equitable apportionment of expenditures and receipts among the various municipalities on account of these purposes.

Not only the experience of Berlin, but universally that of all other cities in Germany and Great Britain, as well as this country, that have established their own gas works, shows the profitableness and economy of this policy. The same is true concerning electric lighting, as demonstrated by a considerable number of American cities that have their own plants. Where cities depend upon private corporations for their electric lighting the average cost is three times that in cities which run their own works. In eighteen cities of the latter class, the average cost is 13.4 cents a night for each lamp; five of these cities formerly paid an average of 45.1 cents to private companies; seventy-five cities, supplied by private corporations, pay an average of 42 cents. Lewiston, Me., formerly paid from 55 to 65 cents a night for lights burning only till midnight; now, with its own plant, it burns its lights all night at a cost of only 14 cents! The town of Danvers is now before the Legislature seeking the right to supply its inhabitants from the plant with which it now economically lights its thoroughfares. Though this is opposed by private interests, it would be manifestly wasteful to allow another plant in private hands for the latter purposes, encumbering the streets with its poles and wires, and there is even better reason why a municipality should supply light than sup-

ply water to its inhabitants, since for the purpose it does not need to invade the territory of other municipalities, as is often the case in obtaining a water supply. Therefore, if the Legislature is wise and not acting in behalf of special interests instead of the public welfare it is solemnly bound to serve, it will not only permit Danvers to do this, but enact a general law enabling all municipalities to do the same. In Grand Ledge, Mich., the municipality does commercial lighting with its public plant, and thereby already gets its own street lights at a cost of only 1.8 cents a night for each lamp.

Chicago now does electric lighting at a cost of 15 cents a lamp a night, while Boston pays the exorbitant sum of 65 cents! Boston paid the last year for its electric lights the sum of $151,413.05, and for its gas lighting $245,337.80. With municipal works the electric-light expenditure ought to be reduced at least two-thirds, or to something like $50,000, and that for gas correspondingly.

The great problem is how to reduce our municipal taxation. It is not to reduce our expenditures, for our needs are increasing, and the tendency of the day is to increase continually the functions of the municipality—and a fortunate tendency it is. But it is possible, by acting in the direction indicated, to obtain an ample revenue to meet these expenditures, wonderfully improving the city and at the same time materially to decrease taxation. That way is to charge every private interest now or hereafter occupying public property a rental equivalent to the full value of the service thereof. A magnificent revenue could undoubtedly be obtained from these sources in which the public rights have been recklessly, but let us hope, not irretrievably, thrown away by both state and city. What would be thought of a proposition to give the use of Faneuil Hall Market to its occupants rent free, or to allow private corporations or individuals to put up their buildings on city land without compensation? Suppose the Commonwealth had given away its Back Bay lands! Yet, that is precisely what we have done with our streets. We have allowed private interests to occupy our thoroughfares wherever possible, on the surface, in the air above or in the ground below, with railways, electric light and power, telegraph and telephone wires, gas pipes, heating pipes, conduits, and Heaven knows what else,—absolutely without compensation, when just as easily as not the city might have obtained for the privilege a splendid income in the shape of a large percentage of the gross receipts of these corporations which are now enriched at the expense of the public. Thereby taxation would be reduced, business interests largely relieved from many burdens, and the general welfare promoted.

If our public-spirited men would only take the matter in hand this can easily be accomplished; let our business men, for instance, discuss

and advocate such measures in their trade clubs, their exchanges, their chambers of commerce, and the pressure of public sentiment thus developed would soon become overwhelming. And it would be well to bear in mind these truthful words from that admirable book of Professor Ely's "Problems of To-day: "Where public spirit is in a low condition public authority is unable to perform its proper functions, and they are with loss handed over to private individuals."

B. THE BERLIN BUDGET.

The New York Evening Post of March 22, in an editorial commenting upon the lecture and an interesting and instructive letter from a Berlin correspondent which it had drawn out, pertinently remarked: "How is all this done with so many theorists, and even college professors, in the executive staff of the city? Simply because they conduct the city's affairs upon business principles."

As the letter gives much valuable recent information, more in detail than was possible within the limits of my lecture, it is printed herewith:

Berlin, March 8, 1889.

"Cyrus has tasted of this dish and wishes that you also might enjoy it." These pleasant words of the chivalrous and unfortunate hero of the Anabasis came to my mind as I read the report of Mr. Baxter's most excellent lecture on our "Model City" in THE EVENING POST some weeks ago. The Berlin Government is now discussing its annual budget, many proposals of reform are debated in the daily press, and it may not be without interest to your readers, at least to such as are active in municipal reform, to learn the result and methods of our financial system in greater detail than it was his purpose to state it, and with reference to more recent conditions; for the more the details of the financial management of Berlin are studied, the more it seems a model of what every city government might be and ought to be.

Death and taxes are said to be the two great certainties. Here at least tax-dodging is nearly impossible, and the inevitable is accepted the more cheerfully since all tax-payers are convinced that every penny which they contribute will be used with scrupulous honesty and business tact for the public good. It is a matter of justifiable pride to our city government that each year shows an advance over the last in efficiency and economy. The officials take the contributors into their confidence, going over each item of the budget with almost painful accuracy in a special report, accounting for each increase and decrease in a detailed comparison with the preceding year. In the weekly issues of the municipal paper, *Das Gemeinde-Blatt*, all the expenses may be traced, even to the number of pencils, of envelopes, and sheets of

paper used during the year, and every one may satisfy himself that a wise watchfulness has left no loophole for speculation. Indeed, it may be doubted if the small tax-payer gets as great a return from any other payment that he makes as he does from his taxes to the city.

Before showing what we pay and what is done with the money, it is worth while to consider a moment what we get. We have the best police system in Europe, order is maintained, crime is rare, unpunished crime an exception. The complete control which the police has over the movements of the population leads many to "leave the country for their country's good," and honest men profit by their absence. If, as is promised us, we have a general strike this spring, there will be no such scenes as have been reported during the car-strikes in Brooklyn or even in New York. There is no street in Berlin that the police cannot control, and the right to work on his own terms will be denied to no one by any body of men with impunity. Order is the first law of cities as well as of heaven, but even in other ways, in courtesy and in bearing, our police need not fear comparison even with "the finest." Cleanliness is next to godliness. Our city furnishes water at a less rate than is usual in America, and the supply is plentiful, the average used being sixty-four litres per head and day. Gas costs us about $1.12 a thousand feet, or 16 pfennige a cubic metre; but it is honest gas and honest measure, and for mechanical purposes it is furnished a sixth cheaper. The streets of Berlin are well lighted, scrupulously clean even in this trying winter, and well paved. Already one-ninth of our street surface is covered with asphalt, and a third of the remainder with hewn stone blocks laid on cement and joints pointed with tar. The wooden pavement finds small favor here. The elevated road and horse-cars furnish Berlin with better transit facilities than has any other continental city. The parks and squares are many and well kept; many places are set apart for the children and kept from disturbing elements, while the child as he grows older finds ready for him model schools and museums and libraries, which, if they cannot rival the historic treasures of earlier collections, are most valuable for training and instruction.

This is what the tax-payer gets; now let him count the cost. The City *Budget* for 1888–1889 reckoned the income and expense for the year at sixty-two million marks. We have finished the year with two million surplus, and hope to reduce taxation during the coming year. Of the sixty-two millions the people paid in direct taxes about thirty-five. Two systems of taxation are used side by side, and each helps to correct the inequalities of the other. These are the income-tax, proportioned to a man's ability to pay, and the rent-tax, an unvarying percentage of the rental value, collected on the theory that the streets, the parks, and city works are for the use of all in nearly equal degrees,

so that, as each renter of an apartment pays not only for the rooms occupied, but also for the common stairways and halls in proportion to his rent, he should pay for the benefits given him by the city in the same proportion. This rent-tax has been the subject of very violent attack by Socialists, whether democrats or statesmen. Bismarck said in 1881 that it was "the most oppressive tax, growing in burden as it decreased in amount, in fact, one of the worst that could be invented," and when a year or more ago the city proposed to the Government to make certain exemptions from the tax, the petition was refused on the ground that it should be discarded altogether. This, however, was rejected last month by the decisive vote of eighty-four to twenty, for our Berlin Burgomaster does not agree with von Helldorf, who says of his party, the National Liberals: "We must go with the Chancelor though we do get a kick now and then."

The present law taxes all dwellings 6⅔ per cent. of the rental value. A proposition is under consideration to reduce the tax to 3½ per cent. on rents below 300 marks and to 5 per cent. on rents below 600. It has very small prospect of success, and would be merely a gift to the present house-owners who bought and built in full knowledge of the law. Rooms used solely for business purposes, the dwellings of ambassadors, clergymen, high officials and teachers are exempt. The tax was remitted also out of charity during the year on over 21,000 lodgings with an average rental of 141 marks. The tax yielded for the past year about 13,000,000 marks.

The rent-tax is not the only charge on real estate, though it is the only one that is paid by the occupant. The owner pays a tax of one-third the amount of the rent-tax, or 2 2-9 per cent of the rental value. The amount realized is about 4,400,000 marks, so that the whole tax on real property is somewhat over 17,500,000 marks. The owner has also to pay small sums for the use of water and sewers, but this does not appear in the Budget.

To recover these taxes the owner looks to the rental, but yet rates remain at a very reasonable figure. Some details may be not without interest, and will invite comparisons, for Berlin is but little smaller than New York, and is growing nearly as rapidly. There were in the city on April 1, 1888, 344,941 dwellings leased, subject to tax, at an average rental of 640 marks annually. City statistics show that about two-thirds of these (222,915) rented at from 50 to 400 marks, or for less than $100 a year; two-ninths (76.827) were valued at between 401 and 1,000 marks; some 19,000 more were rated between 1,001 and 1,590 marks, and 10,000 others below 2,080 marks: so that more than nineteen-twentieths of the rents paid were less than $500. Eleven thousand fell between this sum and $1,000, while in the whole city only 5,121 dwellings had a rental value of more than this, and of these but

1,182 were rated at over $2,500. I will leave it to the reader to draw his own comparisons.

The other great source of revenue is the income tax, which produces about fourteen millions. As far as the city is concerned, incomes up to six hundred marks are free; from thence to three thousand marks the "class tax" rises in a progressive scale from nine to seventy-two marks annually. The state collects an equal tax, but includes the incomes below six hundred marks in two classes, which pay respectively three and six marks annually; while, therefore, the city gets from this source less than three millions, the State collects nearly four millions and a half. Incomes above three thousand marks are taxed 3 per cent by the State and equally by the city. Of such there were in Berlin, last April, 36,464. These were divided into classes ascending by steps of six hundred marks to six thousand marks, and by steps of twelve hundred marks, and so on, the largest income assessed Herr Bleichröder's being 2,460,000 marks.

As with rents, here it is interesting also to observe the distribution of incomes. Under one or the other of these income-taxes are ranged 477,611 persons; three-fifths are exempt from the city tax, since they earn less than 600 marks. More than half the remainder have incomes below 3,000 marks. Of the 36,464 who pay income-tax at 3 per cent, one-third (12,291) pay on incomes under 4,200; a second third (12,512) rank between 4,200 and 7,200; about two-ninths (8,095) have incomes between this figure and 14,400; less than a tenth (3,302) have between this sum and 60,000. Above this amount there are but 380 incomes in Berlin; 34 of these are above 300,000 marks, representing that number of millionaires according to American reckoning. One other tax, the dog-tax, is paid directly by the people. This is rather a license than a tax, however. It produces about 350,000 marks.

An active discussion is now in progress on the method of estimating the income to be assessed. The present system is largely a rule of thumb. It seems usual to estimate the income of the middle-class at about three times the house-rent, increasing the ratio as the rent rises. This is evidently a tax rather on outgo than on income, and it is generally recognized that most incomes are underestimated. It is now proposed, with every prospect of success, to require each person to make a sworn declaration of his income. This would distribute the burdens more justly, and though many oppose it, it could be enforced if it were undertaken. Foreign residents especially seldom are taxed for a third of their income, often for not more than half their actual expenses. I will give a single instance. There is now in Berlin a Boston gentleman who had an unfortunate prejudice against lying to the assessors, and paid in his native city about three hundred dollars in taxes annually. On the identical property he pays here as a permanent res-

ident thirteen dollars rent tax and forty-five dollars income tax, "and he never told a lie." If fully assessed by city and state, his tax would be but one hundred and three dollars annually. Indeed, I do not know of any place in America where the tax-dodger is so well off materially, to say nothing of the sense of moral rectitude which comes from an honest though inexpensive discharge of one's civic duties.

But to return to the Budget. Direct taxation produced last year about thirty-five million marks. The sources of the remainder of the city's income shall be indicated more briefly. The gas-works paid the interest on their cost, lighted the city without expense, and had a surplus of four and a half millions. To this the water-works added seventeen hundred thousand, with no charge to the city, and the public markets contributed three hundred thousand. There was, however, a deficit in the sewerage of two and a half millions, so that the city works netted only about four millions. Licenses, rents, and sales furnished seven and a half millions, the largest item being the tax of two to seven per cent on the gross receipts of all horse-car lines, which produced more than a million marks. Fines and fees furnished a million, school rates two millions, the work-houses and insane asylums thirteen hundred thousand, the malt tax half a million, and minor sources of revenue three millions. About nine millions was raised by the issue of three and a half per cent bonds for permanent improvements.

This brings me to the debt of Berlin which reached last April the total of 182,578.000 marks. Of this, 149,874,000 marks represent the cost of the city works, gas, water, sewers, abattoirs, and markets, which pay interest and sinking-fund from their receipts and leave a handsome balance to the city. There remains 32,704,000 marks, calling for an annual charge for interest and sinking fund of less than 1,660,000 marks, or about 25 cents per capita. This is less than half the annual surplus from the city works. Yet even this exaggerates the real debt, for the city had an invested surplus of 10,000,000 marks, to which it has added 2,000,000 during the past year.

It may be mentioned that the city collects also the rates for the support of the State and Roman Catholic churches from their members and manages a system of mutual insurance against fire assessing the loss annually. For the year ending October, 1887, there were 2,500,000.000 insured at an annual cost of one-twentieth of one per cent.

It has been shown how the city raised last year 62,000,000 marks. To note the use that was made of it may be of advantage. For collecting the direct taxes 260,000 marks were appropriated—about eight-tenths of one per cent.—and so skilfully was payment enforced that the loss, except by death or removal, is hardly appreciable, while the collections for the preceding year exceeded the estimates by 1,640,000

marks. Other statistical and clerical work absorbed 150,000 marks. The city government, including the Fire Department, cost 5,500,000 marks, the police 3,000,000 the streets 2,250,000, the parks 750,000, the city works 2,500,000 marks. These were the necessary expenses of administration; besides this, the city gave 11,000,000 to education, 3,000,000 to the hospitals, more than 6,500,000 to the poor, and had 15,000,000 for the important extensions of the sewerage and the large public buildings now in hand.

That the picture of the direct burdens which German taxpayers endure, and from which they are supposed to suffer, may be complete, let me add that in addition to the city taxes, the state exacts only a 3 per cent income tax, or the reduced tax on incomes below 3,000 marks, a trade-license tax, which yields in this city 2,500,000, and a tax on improved real estate of about 5,250,000 marks annually. Let it be remembered that with these taxes and a moderate tariff Germany supports the strongest army in the world, at about the cost to the United States of her weak army and great herd of pensioners, and it will be seen that in managing a state or a city great results can be accomplished by honesty and economy, with means that in America are often thrown away.

GEOLOGICAL AND MINERALOGICAL NOTES, No. I.

Sodalite.

BY JOHN H. SEARS.

The discovery of this rare silicate was first brought into notice in Essex county by Gilbert L. Streeter, Esq., in October, 1855. The locality of the discovery as described is on the right hand side of the road leading along Collins Cove from the Salem Alms House to Hospital Point. This mineral, when first described, was called *cancranite*. Later it was analyzed by Mr. David M. Balch and proved to be sodalite.

It was found in veins of syenite, which is composed of plagioclase, feldspar, hornblende, eläeolite, biotite mica and magnetite iron, with accessory minerals of zircon, apatite, quartz, albite, augite and small crystals of orthoclase. This sodalite is of a rare occurrence, and seems to be in pockets in narrow veins. From my own observations, I have found it only where these narrow veins, three or four inches wide, are cutting through porphyritic diabase. In these pockets it is quite plentiful, coloring the rock in blotches of pink and blue.

In April, 1862, Messrs. D. M. Balch and C. H. Higbee blasted in a vein of the eläeolite zircon syenite that was discovered ten rods N. W. of the old locality, when specimens of the sodalite and eläeolite were obtained. These

were analyzed by Mr. Balch and the results published in the Proceedings of the Essex Institute, Vol. IV, pp. 3 to 6.

During the past three years, I have given much time to the study of these syenites, and have collected specimens from Fluent's Point, Peach's Point and Naugus Head on the Marblehead shore, Salem Neck, Winter Island, Beverly Cove, Hospital Point, Curtis' Point near Mingo beach, West Beach; West Manchester, East Wenham to Essex and on Coney Island and Coney Island ledges, Haste ledge, Great Misery, Chubb's Island, the Ram Islands, House Island and also at Manchester High Rock, where it forms dykes from a few inches to several feet in width. The Ram Islands are principally albite-feldspar granite, with the syenite cutting the islands on the southwest, as dyke masses. The trend of the whole syenite rock mass is N. 60°, E. to S. W., dip variable. I have prepared twelve microscopic sections, which I have studied in detail with a petrological microscope at the Lithological laboratory of Harvard University, Prof. J. Elliott Wolffe, instructor. One very interesting form of which I have four sections, two from Salem Neck east of Fort Lee, and the others from Beverly, contains a form called micro-pethite. It is a microscopic intergrowth of albite and orthoclase, the orthoclase twinning and the albite intergrowing directly across the twinning planes, giving a beautiful play of colors under polarized light.

I have over one hundred specimens of sodalite, that I have collected on Salem Neck east of Fort Lee and on some of the islands in the harbor which is equivalent to saying that it is not a rare mineral in Salem. Several very interesting forms, that are quite unknown, are still to be studied in order to clear up the relationship which these syenites bear to the granites and diorites through which they cut. One peculiar form has been called leop-

ardite and napoleonite. These names would bring them into the diorite group, but their composition proves them to be forms of the syenite, which is as distinct from the diorite as the diorite is from the granite. On the Beverly shore the syenite is cut in various directions by recent dykes of feldsite and diabase, and at Hospital Point, Beverly, on the east side, there is a peculiar form of dyke called a laccolite, one of which has been described by Mr. G. K. Gilbert. It was discovered in the Henry mountains in southern Utah and consists of large bosses of lava, which have risen from beneath, but, instead of finding their way to the surface, have spread out laterally and pushed up the overlaying strata, giving it a somewhat dome-shaped appearance.

The main rock-mass of Salem Neck is diorite, composed of oligoclase, feldspar and hornblende. The accessory minerals as seen by the microscope are calcite, biotite, apatite, orthoclase, grains of quartz, magnetite iron, limonite, zircon crystals and chlorite. Most all of these are alteration products of the hornblende. This diorite assumes various forms in different places even in the same strike and dip, the strike being N. E. to S. W., and the dip 60° N. W. In places on Salem Neck, it is composed of large patches of hornblende and oligoclase feldspar with magnetite iron. In other places it is largely hornblende and again oligoclase. Some of it is very finely and evenly mixed and again it is seen strongly porphyritic, with large crystals of the oligoclase feldspar, and in some sections it becomes quartz diorite, but this I think is due to the granite, with which it is associated, as I have only observed it in places where the hornblendic granite was closely joined to the diorite.

It has been stated that the sodalite on Salem Neck was found in drift-boulders. This is clearly proved to be in-

correct; still it might have been found in boulders, which are produced by chemicals and atmospheric disintegration as oxydation of iron, solution of the salts, alteration of the hornblende, or hydration of the feldspar. Everywhere on the Neck this process may be observed. Even whole ledges of syenite and diorite, with diabase dykes cutting through them, are seen reduced to decayed rock. Change of temperature from hot to cold causes expansion and contraction. This cracks the rocks, thus letting in rain-water, charged with carbonic acid, which causes disintegration and a gradual rounding of the rock-masses. The granite boulders of Peabody are actually standing upon other boulders of the same kind of granite, which are covered by the rotted granite, which forms the soil over and around them. This is conclusive proof that their origin is from disintegration *in situ* and not from glacial deposits from a distance, also that the so-called glaciated surfaces under them are merely fragments of slickensides. A visit to any of the granite quarries either in Peabody or Rockport will prove the presence of these slickensides at each joint plane at various depths from one to sixty feet. Some of the deepest and most extensive quarries in Peabody are in massive boulders which show in outline the disintegration of the joint planes. In the comparison of joint structures between the Peabody and Rockport quarries we may form some idea of the amount of erosion that has taken place at Peabody and vicinity. At Rockport the upper joints are from three inches to one foot thick and at sixty feet deep in the quarries they are from fifteen to twenty feet thick; while in the Peabody quarries the upper joints are from twelve to fifteen feet thick and the second joint is often twenty-five feet thick. Now if this granite is part of one continuous sheet across Peabody to Rockport the amount of erosion at Peabody must be from sixty to seventy feet,

and where one of these joint structures twenty-five feet thick has disintegrated and eroded on its outside leaving a nucleus we may expect to find boulders like Ship Rock and others of similar size in its neighborhood. These eroded boulders of granite at Peabody, Beverly, Manchester, Gloucester and Rockport form the entire basis of the so-called "Frontal moraine theory" of which, after a careful examination of the region, I find not the slightest evidence; indeed, there are no erratic boulders in the whole region. Those which have been considered as such are clearly fragments of dyke masses which cut the granite. Several forms of coarse diorite, syenite, feldsite and gabbros cut these granites in various directions, and nearly all of them have become in part somewhat schistose and stratified by alteration making a great variety of forms. Now what is more natural than that we should find fragments formed from these dyke rocks mixed with the granite boulders of the region in which they are found *in situ.*

In the early spring I pointed out several examples of these disintegrated ledges of granite syenite and diabase to Mr. John L. Gardner, 2nd, of Boston, and also the Laccolite dykes at Beverly. These he kindly photographed for me and as they illustrate my work on this disintegration *in situ* they are extremely valuable additions to the geology of Essex County.

The so-called syenite of Moulton's point, South Salem, is a true granite, composed of quartz, orthoclase, feldspar and glaucophane. This glaucophane is the blue hornblende, considered as rare by Professor Rosenbusch, described and analyzed by Professor Bodewig from specimens collected on the island of Syra and the Zermatt. Accessory minerals are calcite, apatite, biotite mica, magnetite iron and an abundance of zircon crystals. I would suggest for this form of granite the distinctive name of zirconiferous glaucophane granite.

Appended is a list of new and rare minerals found in Essex County.

Xanthosiderite from Rockport, analyzed at Massachusetts Institute of Technology.

Turgite from Beverly Farms, analyzed at Massachusetts Institute of Technology.

Wad Bog Manganese from Peabody and Danvers, analyzed at Massachusetts Institute of Technology.

Glassy crystals of albite, Gloucester, analyzed by Mr. Whittle, Cambridge.

Ankerite from Gloucester.

Pierosmine, Piorolite, Baltimoreite from Newbury.

Crystal of quartz, a pseudomorph of fluorite, Rockport.

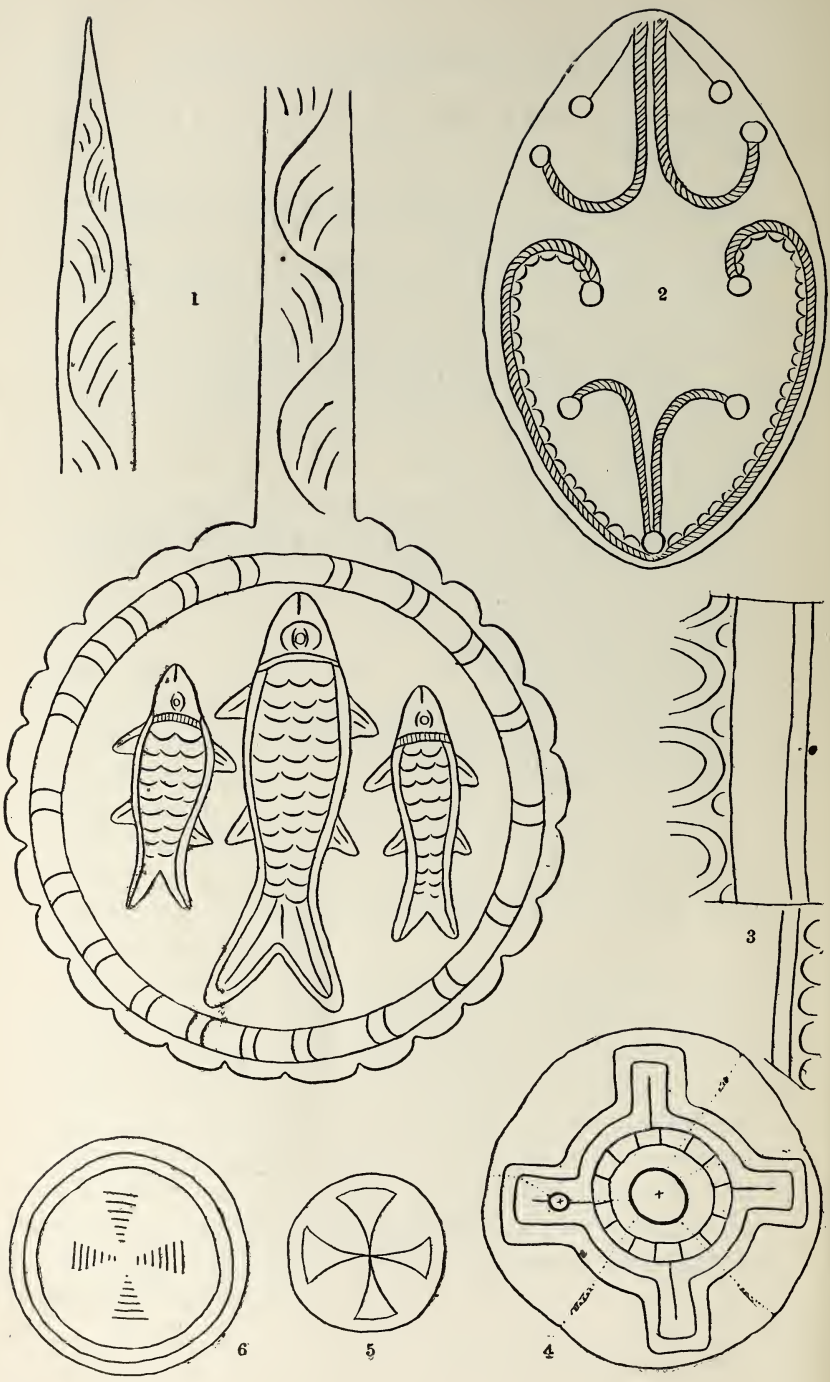
Molybdenite from Gloucester.

Galenite from Rockport.

Delessite from Bradford.

Arkose from Saugus.

Arsenophyorite from Salisbury Point.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ON THE AGE OF THE ANDEAN MEDAL.

(WITH PLATE.)

BY SAMUEL GARMAN.

THE reason for the existence of the present communication is to be found in a letter from the distinguished ethnologist, Dr. M. Uhle, of the Königlich Museum für Völkerkunde at Berlin, Prussia. His letter is a consequence of the article "An Andean Medal" published by the Essex Institute in Vol. xx, p. 57, of its Bulletin. Lacking time and opportunity to make proper study of the matter in its various bearings, that article was limited to merely putting the medal on record by means of a description and sketch, and necessarily the more important work of comparing and identifying was left to investigators who might find the subject more directly in their own lines of study. A considerable portion of what was thus neglected has been admirably supplied by Dr. Uhle, one entitled by attainments and position to speak with authority. The Doctor's letter was accompanied by several tracings of the implements to which he makes reference and of these an approximate idea is given in the pen-and-ink sketches, 1, 2 and 3, on the plate. As the designs were traced with a pencil, by rubbing it over the paper placed against the ornamentation, a very exact copy of the original will not be expected in ink. Such as it is, however, it is sufficiently close to illustrate the points made in the note, besides giving a tolerable representation of the styles and workmanship of the period to which they belong.

By comparison of the sculptures on the pin, or needle, fig. 1, with those on the medal it will be seen that the fish-scale curves, bow-like ornaments, on the two are alike and, so far as may be determined from the tracings, made in the same manner by means of similar instruments. Each excavation has the same remotely sub-crescentic outline, apparently made by a tool, having a point formed by the meeting of three planes, not held perfectly erect, laterally, but inclined toward the side of the groove having the longest slope. One side of the furrow, the nearer to the inner edge, has a steeper descent than the other. In a transverse section of one of these grooves the side nearer the inner edge approaches a vertical while the other side is indicated by a much longer and less abrupt incline. It is evident the execution in each case is what might be expected from workmen using similar tools and methods and, in connection with the designs, it points toward a fashion prevalent at a particular period. The subjoined letter throws light on the probable time when it prevailed.

In my description of the medal the outlines of the central portion were said to make a flower-like figure. It was not intended by this to say that it had been designed to represent a flower. The resemblance may be wholly accidental, resulting from the employment of the semi-circular curves and the straight lines in producing one of the many and varied forms of the "sun symbol," or "sun cross." Some of the forms taken on by these latter are shown in figs. 4, 5 and 6 of the plate, copied from articles in the January and February, 1889, numbers of the Century Magazine, by Mr. Charles de Kay on Pagan Ireland. Fig. 4 is from the upper stone of a quern, hand mill; the dotted line marks the cracks and the x the holes through the stone. It is to be noted that there are fourteen small spaces outlined in a circle near the centre. The

number is duplicated in the Andean Medal. Whether this betokens more than a coincidence is a question for those better versed in interpretations of these symbols. In fig. 5, from a gravestone, the triangular enclosures are sunken below the balance of the face, which from their borders, within the circle, is rounded up in relief. Fig. 6, is said by Mr. de Kay to have been from a "hammered gold spangle with pagan sun cross."

The occurrence of these sun symbols mixed in with those of the church, on gravestones and crosses, and in places of worship in Ireland, is suggestive of a possible influence, through the emissaries of the church, upon the art fashion in Peru at the time of the maker of the medal, or earlier. The idea is only a suggestion but so far as it has any weight it favors the opinion of Dr. Uhle that the medal is of later date than the advent of Columbus or Pizarro. As in Ireland, so in South America, pagan practices were woven in with those of the church, or at any rate were indulged in long after the attempt at suppression. According to the Doctor, the medal derives additional nterest from the fact that the circumstances of its discovery, in connection with the date of its origin, indicate the persistence of the custom of making mummies, and of putting metal in their mouths, long after the commencement of the bloody struggle for the displacement of the symbols of sun-worship in the "land of the sun," by those of Christianity. The following is quoted from the letter:

"It is true that round pieces of metal have been inserted between the lips of mummies by the ancient Peruvians. M. Squier has described some, and I know others of gold of round form with a round hole near the border. You think that the medal may prove of some account in researches concerning the metal workers of the lands of the Incas." But there can be no doubt about that. The date

of the medal, however, is later than that of Pizarro and Columbus, because there are to be seen the ornaments characteristic of the subsequent period, commencing with the advent of the Spaniards. The ancient Peruvians had no flower-like ornaments of the form visible on the Andean medal. This form is characteristic of the work of the Spaniards in America, in Peru, in the eastern part of South America, etc., and of those of the aborigines whose works were influenced by the instruction and direction of the Spaniards. Compare the calabashes of the Rio Amazonas, of Argentinia, of Peru, and elsewhere. I know no ancient work of Peruvians, in silver or in any other materials, on which are to be found the bow-like ornaments so numerous on the medal. But I do find the same in a modern silver lamp of the high plateau of Bolivia, worked perhaps in Sicasica, on a modern trumpet from Peru, of wood, with silver rings and the inscription "Soy de me doeño de Simon Ynostrosa de 1819", on vases of clay fabricated during the last centuries in Ecuador, on the modern silver works of the Araucanians, and on a fine silver needle from Peru originating in the times following the conquest. I send you sketches of the silver needle from Peru (1) of the ornamentation of Araucanian silver works (2) and of the ornaments on the modern trumpet (3). I hope that you incline toward my opinion, that the "Andean medal," though old, is not older than the conquest by the Spaniards, and that it originated in culture of a European character, European ornamental art, etc., introduced by them. However that may be, the medal is interesting in every way; it shows that the custom of mummifying the dead and also the custom of inserting pieces of metal between the lips may have been continued long after the conquest, against the wishes of the representatives of the church."

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NEW INVERTEBRATA FROM THE COAST OF CALIFORNIA.

BY J. WALTER FEWKES.

THE marine animals, described in the following pages, were collected in the months of February, March and April, 1887.[1] During this time, as a guest of Mr. A. Hemenway of Boston, I carried on studies at Santa Barbara and the neighboring island of Santa Cruz, at Monterey and the city of Santa Cruz. My attention was especially turned to the Medusæ of these regions, and a few observations were made on certain novel genera of other invertebrated animals.

MEDUSÆ.

SYNCORYNE OCCIDENTALIS sp. nov.

(PLATE III, FIGS. 2, 3.)

One of the most common genera of Hydromedusæ found at Santa Cruz, is a Sarsia closely allied to *S. rosaria* A.

[1] This paper was prepared for publication while the author was connected with the Museum of Comparative Zoölogy at Cambridge.

I am indebted to the Curator, Mr. A. Agassiz, for assistance in the preparation of the plates and for valuable suggestions.

Ag., but somewhat different from this species or any Sarsia yet described.

The bell of the oldest specimen observed has a pointed apex with thick bell walls. The height of the bell is greater than its diameter. The proboscis rarely projects outside the bell opening, its length not being much greater than that of the height of the bell cavity.

The tentacles are long, filamentous, with scattered nematocysts. The tentacular bulbs are large and prominent and of a yellow color, each with a prominent black ocellus. There are four narrow, unbranched, radial chymiferous tubes.

In a younger specimen (fig. 2) the outer surface of the bell is strewn with clusters of nematocysts. This immature form has but a slight apical prominence and the tentacles are shorter and more stumpy than those of the adult. This species was found in the Bay of Monterey, at San Francisco and at Santa Barbara.

Syncoryne rosaria A. Ag.

(PLATE IV, FIGS. 1, 4.)

This hydroid[1] was collected in great quantities on the spiles of the wharf at Santa Barbara, where it occurs upon the fronds of algæ and the tunics of Tunicates and other animals. It forms small clusters consisting of hydroid heads growing from branching basal tubes. Each tube, bearing a single head, is unbranched.

The head is white, or slightly pink in color, with five terminal, club-shaped tentacles, forming a ring about a central mouth-opening. The remaining tentacles of the head are more scattered, and arranged with little regular-

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[1] This is supposed to be the same as the Coryne of A. Agassiz, but as he does not give a figure of *C. rosaria* I am not sure that they are identical.

I have followed Allman in limiting the name Syncoryne to those Corynidæ with free hydroid Medusæ.

ity, but are found in all conditions of growth and of various sizes.

CAMPANULARIA OCCIDENTALIS sp. nov.

Prof. S. F. Clarke mentions three species of Campanularia from our Pacific coast. *C. everta* is recorded from San Diego; *C. fusiformis* from Vancouver Island and Santa Cruz, while the locality of *C. cylindrica* is not given.

A Campanularia, which differs from these, was found by me at Santa Barbara.

The stem is irregularly branched and of light brown color. It is ringed with moderate sized ferrules, with four annulations at the basal joints.

Hydrothecæ are large, cup-shaped, slightly bulging at the sides, with an *entire, not dentiferous rim.*

Gonothecæ large, oval, tapering from attachment to truncated, distal termination. Orifice small, with slightly raised lips. Sporosacs conspicuous, numerous, readily seen through the sides of the gonothecæ.

Polypites have a brownish yellow color; their tentacles are slightly webbed.

ATRACTYLOIDES FORMOSA gen. et sp. nov.

(PLATE IV, FIGS. 2, 3.)

Stems solitary, erect, brownish, with masses of attached algæ on their external surfaces. The distal ends funnel-shaped. Attached to a creeping stem. Each polypite (hydranth) projects from a cup-shaped hydrotheca.

Hydranth with single circle of tentacles; mouth and intratentacular region of whitish color. Hydrothecal base annulated.

The sporosacs arise from the base of attachment on solitary, erect stems. Each male capsule has a central axis (spadix) which has a green and yellow color. Near its

distal end the spadix is enlarged into a disk-shaped structure, and about midway in its length there arise lateral branches from which originate the spermatic masses. The proximal part of the spadix is connected with the inner wall of the male capsule by a network of fibres represented in fig. 3. At the distal end of the same organ the walls of the spadix and those of the capsule are similarly united. Spermatic elements are formed inside the sporosac and are developed from the external walls of the spadix, probably making their way out through an opening in the distal end of the sporosac. The female Atractyloides was not observed.

PERIGONIMUS FORMOSUS sp. nov.

A Perigonimus, which resembles *P. serpens* Allman, was taken at Santa Cruz.

Stem small, creeping, sending up at intervals small, chestnut-colored tubes. No hydrothecal enlargement. Stems simple, branching, slightly annulated.

Polypites with reddish-yellow hydranths, each with from ten to sixteen tentacles and a prominent circumoral knob. External walls covered with unicellular algæ. Tentacular nematocysts prominent.

The gonosac arises from the creeping stalk and is a capsular body found in numbers in different regions of the colony. The ovisac forms at the extremity of a simple tube not unlike that which bears the hydranth. This tube is slightly annulated and at its distal extremity is enlarged into a spherical body of dark crimson color enclosed in a transparent sac.

The mode of formation of the ovisac separates this species of Perigonimus from others which have been described. No medusa was observed and the color is very different from *P. serpens*.

It is believed that the ovum after segmentation devel-

ops into a planula in its sac, and separating from this organ follows a similar course of development in one or two other genera of hydroids. If this supposition be correct, this is an exceptional method of development for this genus.

POLYORCHIS PENICILLATA A. Ag.

(PLATE IV, FIGS. 6, 7.)

Many specimens of this Medusa were found near the wharves at Santa Barbara, Santa Cruz and San Francisco. The jelly-fish is very conspicuous on account of the circles of dark-purple tentacular bases and the extended wreath of the tentacles. It is the most magnificent of all the west coast Hydromedusæ which were observed.

The bell is large, about one and one-half times as high as broad. It has a slightly yellow color and a small, rounded apical prominence. The bell walls are thin and of about uniform thickness throughout.

Radial tubes four. Each radial tube has lateral branches which arise in pairs opposite each other. These lateral branches often subdivide or become forked at their ends. The largest subdivisions are situated about half the distance from the apex of the bell to its margin. The lower extremities of the four radial tubes, at their junction with the circular tubes, are ordinarily destitute of lateral appendages. The motion of the bell is sluggish, not unlike that of Nemopsis.

The length of the tentacles is greater than the altitude of the bell, and these organs are ordinarily, when at rest, carried at right angles to the bell walls. A. Agassiz found, in the specimen which he described, thirty-six tentacles, or eight between each pair of tentacles which hang from the neighborhood of the junction of the radial and marginal canals. In the largest specimens which were taken at

Santa Barbara, there are more than thirty-six tentacles or sixteen on a similar section of the bell rim. Counting all the tentacular appendages in many specimens there are, on an average, sixteen between each pair of radial tubes. The four tentacles of the radial tubes and those from the bell rim, midway between these, are much larger than the remainder, even in adults.

The tentacles arise in three series, at different heights on the bell rim. They vary very much in size and number. The largest and longest tentacles are found at the peripheral ends of the radial chymiferous tubes and arise high up on the outer bell margin. The smaller tentacles are simple clubs with a conspicuous pigment spot. All tentacles have bright pigmented eye-spots.

The larger tentacles are connected with the marginal tube by a small vessel, passing through the substance of the bell to the circular chymiferous vessel. It thus happens that the purple color of the base of the tentacle appears quite a distance from the marginal tube and the tentacular base does not lie directly on the marginal vessel as in some genera of hydroid medusæ. The tube connecting the cavity of the large tentacle with the marginal vessel extends at right angles to the external wall of the bell. The tentacular bases seem to be placed on the outer bell wall and from them the tentacles extend peripherally outwards. The tentacular bases are thickly colored with dark purple pigment. Each tentacular base has a well-defined pigment spot or ocellus, which seems to be situated high up on the sides of the bell, on account of its basal attachment.

The tentacles are long, hollow and flexible. They have a reddish color and bear many clumps of nematocysts.

The smaller or intermediate tentacles, placed on the bell margin between the larger just mentioned, are in-

serted on the bell margin lower down on the bell and nearer the marginal tube. The smallest of these lie directly upon the marginal vessel and have no tube connecting their bases with the cavity of the vessel.

No otocysts were seen. It is important to know whether otocysts exist or not, for in the original description of Polyorchis this point was left in doubt. I have repeatedly searched for otocysts and my search supports the opinion that these bodies are wanting in Polyorchis.[1]

The proboscis is mounted on a conical or rounded gelatinous extension of the bell which is crossed by the four radial tubes. The lateral branches of the tubes hang from this prominence of the bell and are not formed in the wall of the true proboscis.

The sexual bodies have the form of numerous long, filamentous threads, hanging down in the bell cavity, in some instances as far as the bell opening. Their color is yellow and they vary in number since many are small and half developed. Although in former descriptions only four sexual bodies are described on each tube, the number was found in some of my specimens to be much greater.

The proboscis is long and flexible and has a pale yellow color. It is trumpet-shaped at the oral end. The mouth is four-parted and often hangs just at the opening of the bell. Food when present can be readily seen through the walls of the stomach.

Nothing is known of the young of the medusa of Polyorchis. The following description of an immature condition of this genus is thought to be of interest.

The youngest stage of Polyorchis which was taken differs in several details from the adult just described, and in its form indicates the affinities of the genus.

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[1] The importance of knowing whether otocysts exist or not in Polyorchis is seen when we remember that this genus has several features in its anatomy which ally it to those Medusæ possessing these structures.

Its bell is oblong, without a prominent apical protuberance, although somewhat thicker in the apical region. The lateral walls of the bell are of about uniform thickness and are colorless. The outer surface of the bell has clusters of nematocysts which are arranged in lines with regularity. These structures have not the same prominence in the adult as in the young.

There are sixteen tentacles which are distributed as follows. At the end of each radial tube there is a single tentacle, which is somewhat larger and longer than the remaining tube.[1] Midway between these on the bell rim, are four other tentacles approaching in size the radials, and between these again small stumps, indications of eight others. The length of none of the tentacles is more than half the height of the bell.

The bases of the tentacles bear reddish patches of color, and a conspicuous black pigment spot which indicates the position of the future ocellus. These tentacular bases lie immediately upon the marginal vessel, while the short tube, which connects the cavity of the base of the tentacle in an adult with that of the marginal vessel, is not developed. There are no otocysts or structures which can be compared to them.

The radial tubes are four in number. Each tube is broad, with indications of the lateral appendages appearing as simple zigzag notches in the gelatinous wall of the tube.

The sexual glands are not developed, but at the very base of the proboscis there are two small buds, just below the union of the proboscis with the inner wall of the bell.

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[1]It is probable that when the Polyorchis buds from its hydroid it has four radial tubes, four tentacles and possibly the stumps of four similar interradial appendages. As the radial tubes at that time lack lateral branches, we have in this stage a medusa closely resembling the young Sarsia. If my suppositions are correct, there seems no doubt that Polyorchis belongs to the true Anthomedusæ, and that it is allied to Sarsia. The rows of meridionally placed nematocysts on the outer bell wall are suggestive in this interpretation.

These buds are probably the beginnings of the future ovaries.

The proboscis is destitute of its rounded gelatinous base, and hangs downward to within a short distance of the bell-opening. The mouth is formed as in the adult. It is four-parted and has frilled lips.

Intermediate stages of growth between this and the adult were collected in March and April near the wharf and in the zone of kelp at Santa Barbara. There was hardly a day, when the water was smooth, during which multitudes of these medusæ were not observed from landing places at Santa Barbara and Santa Cruz. They appear also to be common in the Bay of San Francisco.

The adult Polyorchis is the largest medusa of Tubularian hydroids, or Anthomedusæ, yet found in American waters. At the same time, it is one of the most beautiful, and its great abundance in California invites one to a study of the unsolved question of its hydroid and early development.

STEENSTRUPIA OCCIDENTALIS sp. nov.

(PLATE III, FIG. 1.)

A hydroid medusa with a single tentacle has never been described from our Pacific coast. Several specimens of a genus which seems to be the same as Steenstrupia were taken by night fishing at Santa Cruz.[1] This is the first mention of this genus from our west coast.

The bell is ovoid, without apical prominence, slightly a-symmetrical. There are rows of meridional lasso-cells extending on the outer surface of the bell, from the marginal end of the radial chymiferous tubes towards the apex of

[1]The display of phosphorescence at night in the Bay of Monterey is one of the most marvellous sights which I have ever seen. Although I have seen similar phenomena in many places, I have never seen it brighter than one night near the end of April at Santa Cruz.

the bell. Radial tubes four, narrow, simple, unbranched. A well-marked velum closes in part the entrance to the bell cavity.

The proboscis is simple, without labial appendages. It is richly pigmented near the oral end and at its attachment to the inner bell walls. A spherical pigment spot indicates the terminus of three of the radial tubes on the marginal vessel. These tubes are destitute of tentacles.

A single, long, flexible tentacle arises from the point of union of one of the radial tubes with the marginal tube. This tentacle is ribbed throughout its entire length with ferrules, composed of nematocysts, as shown in the figure.

Immature forms of the young appear budding from the base of the single large tentacle near its attachment. These young medusæ vary in size from a simple enlargement to an individual just ready to separate from its attachment and approximately resembling the adult. Many of these have the single long tentacle developed, but in none were the other tentacles comparatively as long in the young as in the adult. In the very young bud, all the tentacles are simple protuberances of equal size. I have especially considered the relative sizes of all the tentacles in the young, for it seemed to me that possibly the genus might betray in those stages affinities with medusæ with four tentacles. It would seem, however, that the predominance in size of a single tentacle dates back to very early conditions.

There is no apical extension of the umbrella or bell, and no remnant of a "funiculus," or tube by which the radial system of chymiferous tubes were once connected with a hydroid.

The structure of the tentacle closely resembles that of Steenstrupia. The movements of the medusa are so accurately described by Forbes for his species, and apply so well to the Californian, that I have taken the liberty of

quoting his account. "But when well and uninjured, it is an extremely active and regularly formed creature, though, owing to the weight and unbalanced tail which it is doomed perpetually to drag as its train, it cannot advance through the water with the easy grace and rapidity for which its allies are remarkable, but struggles forward with frantic energy, contracting and expanding rapidly, and without ceasing, reminding us of an escaped felon impeded in his course by the dragging of his heavy fetters."

An asymmetrical genus of hydroid medusæ called Hybocodon, figured and described by Agassiz, is found on the Atlantic coast. The Steenstrupia from California, while in general character it closely resembles the genus Hybocodon, is much larger and has a somewhat differently formed bell.

The Californian Steenstrupia differs also in a marked manner from either *S. rubra* or *S. flaveola* Forbes, from the British seas. The former bears on the apex of the bell a "little tentacle-like, fleshy-red appendage," while the bell of the latter is more conical. Neither of these species is represented by Forbes with young buds on the tentacular bases and there seems some evidence to believe that both of Forbes's species are immature.

I was unable to find the hydroid Corymorpha, nor have I taken this hydroid in California, but it is probable that it will be found in abundance as the medusa is common.

Willia occidentalis sp. nov.

(PLATE V, FIG. 3.)

There are two species of Willia on the Atlantic coast, both of which are southern in their habitat, although one, *W. ornata*, has been found by me once at Newport. On the Pacific coast, no Willia has ever been described, al-

though a similar and larger genus, Proboscidactyla, is recorded from certain places.

I found at the island of Santa Cruz a medusa which was at first mistaken for a young Proboscidactyla, but which turns out on closer study to have marked differences from this genus.

The bell is semiovate, with a slight constriction in its external outlines on a level with the base of the proboscis. Ovaries are four in number, arranged at the base of a four-parted stomach. Gastro-vessels four, subdivided before their union with the circular vessel into four branches. Opposite the junction of each branch with the circular vessel, there arises a simple tentacle. The margin of the bell bears twenty tentacles. Each tentacle is colorless, and at its base or bulb bears a bright colored, reddish ocellus.

Each tube of the radial system before junction with the marginal is first divided into three divisions, two of which subdivide into two more. The median of the three original divisions extends directly to the bell margin.[1]

On the outer surface of the bell, between each pair of tentacles, there is a cluster of cells,[2] connected with the rim of the bell by means of a simple band, which is narrow and inconspicuous. The cells are similar to structures in an identical position in Gemmaria, and correspond to like organs in our east coast Willia with four tubes, before the lateral branches have formed. In the Atlantic species, *W. ornata*, these structures are evidently embryonic, and the same may be true in the Pacific species of this genus.

The special function of these cells and of this band is not clear to me. They may possibly be comparable with the embryonic tentacles of the larval Glossocodon.

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[1]In Willia from the Atlantic each tube is divided into four subdivisions, before junction with the tube of the bell margin. In *W. stellata* there are six of these tubes before division.

[2]I did not detect the coiled thread in the interior of these cells.

MICROCAMPANA CONICA gen. et sp. nov.

(PLATE IV, FIG. 8.)

This interesting medusa was collected under the lofty cliffs of Punta Diablo on Santa Cruz Island. It differs from others in the possession of *six* radial tubes and a simple club-shaped tentacle.

The number of radial tubes among the medusæ of the Anthomedusæ is generally constant, four or multiples of four. The majority of genera have four of these tubes; some have eight and more, while but one or two are said to have six. Four is the constant number which prevails even through the Siphonophora and its multiple is an almost constant feature among the so-called Discophora. The genera with six radial tubes are marked ones as introducing a new unit in an almost universally quadruple series.

The other structural features of Microcampana are different from those of any hydroid genus with six radial tubes, while the character of the tentacle is very exceptional.

The bell is asymmetrical, conical, smooth, transparent, with a long conical apical protuberance. Clusters of nematocysts are irregularly scattered upon its outer surface. The apical protuberance of the bell recalls a similar appendage in Saphenia, Stomatoca and Amphinema.

The bell has six radial tubes, a marginal vessel, and an apical tube or funiculus ending blindly in the apical prominence. The radial tubes are narrow and simple without lateral branches.

The marginal appendages to the rim of the bell are of two kinds. At the peripheral end of five of the radial tubes there are simple projections or protuberances, which are densely pigmented. From the extremity of the remaining radial tube there hangs a club-shaped tentacle which recalls in structure the tentacles of the genus Di-

purena. This appendage is clavate, stiff, enlarged into a globular body at its free extremity. At its base, where it is attached to the bell margin, there is a tentacular bulb which resembles the stumpy appendages of the other five tubes. The club-shaped appendage swings freely on its attachment and is sometimes, by the contraction of the bell, thrown directly across the opening into the bell cavity.

The proboscis of Microcampana is simple, without appendages, having a slightly darker color than the bell. The bell has a pink color, the tentacular bases are bright red, and the proboscis is yellow.

The function of the single, stiff tentacle can hardly be supposed to be the same as that of the long flexible appendages of Sarsia or Steenstrupia. It is almost identical in form with that of the four tentacles of Dipurena and possibly has a similar function.

Its distal extremity is less dumb-bell shaped than in the last mentioned genus, but the internal wall has a similar pigmentation.

Velella meridionalis sp. nov.

(PLATE I, FIGS. 1, 2, 3; PLATE II, FIG. 3.)

The only member of the Velellidæ which has been mentioned from our west coast is a Velella closely allied to *V. Septentrionalis* Esch. Eschscholtz gives a figure which easily distinguishes his medusa, but shows a marked rectangular form in the veil or float which the more southern species does not have. In most of the southern representatives the umbrella is more oval than that figured by Eschscholtz. Although it is possible that the individuals studied by me were young, the many differences which exist between the specimens which I collected and those collected by Eschscholtz, would seem to show that two species of this genus exist on the Californian coast.

Velella meridionalis has an oval-shaped mantle of a blue and yellow color. When seen from the edge it is thin and flexible. This part, ordinarily called the body, floats on the surface of the water. Embedded in it, placed at an angle to the longer diameter of the ellipsoid umbrella or mantle, there is an oval, flat body called the float, which is composed of two thin plates of horny character united by a number of concentric partitions, the edges of which are seen in Plate 1, fig. 3. The concentric chambers separated by these partitions are filled with air or gas, and form an organ of flotation. They communicate with each other by openings and exteriorly by a row of orifices placed diagonally across the upper side of the float. The float is placed left-handed across the umbrella, or if the longer axis extends vertically, the upper end of the float is to the left of the observer, the lower to the right. This was invariably the position of the float of all the specimens examined.

On the upper side of the float there rises a thin chitinous plate of triangular shape, the apex of which is above, the longer side placed slightly diagonally to the longer axis of the float. Over the float is spread a thin membranous body, a continuation of the mantle through which ramifies a system of vessels.

The two sides or edges of the triangular sail which are free, are skirted by a continuation of this membrane forming a contractile extension. The sail is carried upright as the animal floats on the surface of the water.[1]

The float of the specimens studied has a vertical crest which like the float itself is "left handed;" that is, when placed before the observer with the central polyp turned from him, the longer axis of the ellipse being placed ver-

[1] A reversal of the float so that the sail is below is generally fatal to the Velella.

tical, it has the upper portion of the crest on the left hand, the lower on the right. The whole float has its axis left handed as regards the umbrella.

The color of the umbrella is yellow and blue, girt by a brilliant blue border. The portion near the float is yellow. The outer edge of the umbrella is entire.

Seen from below the oval float was observed to bear three kinds of appendages, which may be known as the polypites, the sexual bodies and the tentacles. The polypite, or central polyp, is a highly contractile, flexible body, capable of considerable motion, enlarged at its base and tapering uniformly to a free extremity on which is placed the mouth opening. This opening is very small, although capable of considerable expansion and extension and has thin lips. It bears no tentacles on its edges. Tentacles are absent from the base of the polypite. The cavity of the polypite serves as a stomach and within it the half-digested food was observed. This consists of smaller medusæ, and other small marine animals, with unicellular algæ. Velella is thought to be omnivorous.

The structures formed around the rim of the float on its under side may be called the tentacles. They are long, thread-like bodies, highly flexible, but not very contractile, arranged in several rows, but never arising from the edge of the umbrella. These tentacles are pointed and situated a considerable distance from the edge of the umbrella as in the young of *V. mutica*. They are covered with scattered nematocysts in irregularly defined bands and disconnected clusters. The tentacles are confined to the lower side of the umbrella and lie on that part of the body which is under the float. There are no appendages to that portion of the umbrella which is situated peripherally to the float. Between the marginal tentacles and the central polyp there hang short stalks with botryoidal clusters of small buds

hanging from the lateral branches. These buds are minute medusæ, or sexual clusters, each one of which lives a considerable time after it breaks away from its attachment.

Each medusa, of which many were raised into the adult form, has a bell-like form with short stumpy tentacles and is destitute of a proboscis. It has four broad radial tubes, alternating with other prominent structures often mistaken for tubes.

The lower side of the chitinous float is concave, in which concavity lies the so-called "liver." This organ forms the upper wall of the base of the polypite, and has a dark brown and yellow color. Canals arise from the concavity of the polypite and after anastomosing penetrate the different regions of the liver, forming a "star-shaped body" in the upper part of this organ.

The liver is also penetrated by tracheæ, peculiar tubes, which arising from the lower plate of the float end blindly in the substance of the liver. These tracheæ, which seem to be concerned in the aeration of the fluids of the body, are sometimes branched and apparently convey air from the chambers of the float into the substance of a gland called the "liver." By a contraction and expansion of the umbrella, as described by Dr. Carl Chun, the gaseous products are expelled at intervals or introduced again through these tracheæ. We have in this genus an air-breathing medusa, as shown by Chun, although it is probably true that there is combined with this method another found in all medusæ, viz.: aeration by exposure of the circulatory fluids through the tissues of the body.

The whole surface of the mantle and the membrane covering the "sail" in Velella are exposed to the air, and probably serve in the respiration of the medusa. The exposure of the water-blood fluid to the air is facilitated by a nexus of tubes which are found in these structures.

In the Portuguese Man-of-War[1] in which the float has the form of a huge bag, the feeding-polyps being clustered on the submerged portion, we probably have a similar respiration by direct contact with the air through the walls of the float. In the genus Physalia there is an opening into the float by which air can enter its interior so that there may be a double exposure, inside and out. Among the Rhizophysidæ we have appended to the under surface of the enclosed air-sac a number of finger-like appendages, often branched, which convey the air into the cavity of the stem of the animal, so that their walls alone separate the air from the fluid. These structures are possibly organs of respiration comparable with the tracheæ of Velella.

Among those Physophores, however, which have nectocalyces and covering-scales the function of respiration is probably accomplished, as in all medusæ, by exposure of the outer surface of the body to the water. In Siphonophores, where the nectocalyces are absent, the float is enlarged or the covering scales are well developed.[2]

In the family of Forskalidæ, which move very rapidly and in which respiration must on that account be somewhat active, the spread of covering-scales and nectocalyces is very large, but the float is very small. In Calycophoridæ, the motion of which is the most rapid of all these animals, covering-scales are often very prominent. A diminution in the size of both nectocalyces and covering-scales is accompanied by an enlargement of the float and a more sluggish habit of life.

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[1] The peculiar movements of the float of Physalia in water which is impure, somewhat resemble the respiratory movements recorded by Chun in Velella.

[2] No satisfactory explanation of the physiological role of the covering-scales has yet been suggested. I believe that they are respiratory bodies which may sometimes perform also as in Athorybia the function of locomotion. Wherever they are wanting their respiratory function is performed by the swimming bell (the float is a modified nectocalyx), when the medusa swims below the surface or by an enlarged float when aerial respiration occurs.

ATHORYBIA CALIFORNICA sp. nov.

(PLATE II, FIGS. 1, 2.)

The beautiful Physophore, Athorybia, has never been recorded from our Pacific coasts. The number of localities in which this animal has been found is very limited. It occurs in the Mediterranean, and has been described by several observers from Villa Franca, Naples and Messina. A species is also described from the Indian Ocean. In 1883, I found a new Athorybia, *A. formosa*, at Dry Tortugas, Florida. A large Athorybia is known from the Canary Islands. Other Anthophysidæ are described by Haeckel. While crossing the Santa Barbara channel, from Santa Barbara to the island of Santa Cruz, a new Athorybia was taken in the drag net.[1] This Athorybia is an interesting one and its discovery important as being the first observation of this genus in the eastern Pacific.[2]

Athorybia differs from other Physophores, except Physalia, in the absence of an axis or stem. There are no nectocalyces and their function is performed by the hydrophyllia. The float is large and conspicuous, standing upright as the animal floats in the water. It consists of a pneumatocyst and pneumatophore, forming two separate globular sacs, one inside the other, both fastened at the upper pole, where there is an external opening in both. The contents of the pneumatophore is air or gas. The color of the float is a delicate pink, with a dark red pigment zone on the upper pole about the opening. At the base of the float there arises a circle

[1] It is a circumstance worthy of mention that this Athorybia, like many other medusæ described in this paper, was found in the vicinity of what is known to fishermen on the Santa Barbara Channel as the "Submarine Oil Well." Near the middle of the channel petroleum is always found floating on the surface of the sea. This is supposed to be derived from the upturned beds of asphaltum under the water. Whether the source of this oil supply is submarine or not, many of my best medusæ were found in close proximity to the floating oil.

[2] With the exception of Physalia, Velella and Porpita, no other Physophores have been recorded from our Californian coast. A fragment of Porpita and one or two mutilated specimens were observed near the island of Santa Cruz in my trip across the Santa Barbara channel. I was, however, unable to identify the species to which these specimens probably belong.

of bracts or hydrophyllia. These bodies are transparent, and extend outward at an angle to their attachment. They are capable of more or less movement, and sometimes act as flappers in the propulsion of the animal.

Each hydrophyllium is elongated, leaf-like, thin, penetrated by a median canal. The outer surface of the hydrophyllium is crossed by lines of lasso-cells, the prominent rows of these structures extending longitudinally across the outer surface of the bract. On either edge of the covering scale, opposite each other and midway between the attachment and free extremity, there is a notch or indentation. The polyp-stem, or that region of the axis of the Siphonophore which carries the polypites, tasters, sexual bodies and hydrophyllia, is reduced in length and enlarged into an inflated bag, continuous with the float.

The tasters are long and filamentous, very flexible, and have a slightly pinkish color. Their tentacles, if they exist, which is doubtful, are very small and rudimentary.

A single, immature polypite was observed, and at this stage the Athorybia is monogastric. This single polypite has an open mouth, with trumpet-shaped lips. Three long tentacles were observed, each bearing tentacular knobs. One of the tentacles probably arises from the single polypite, the others from immature organs of the same character. Clusters of half-developed tentacular knobs were observed on the polyp-stem or polyp-sac, for the polyp-stem is here reduced to a globular enlargement, at the base of the larger polypite.

Each tentacular knob, fig. 2, consists of a peduncle, a sacculus, an involucrum, two terminal filaments and a median vesicle. The peduncle, or base of attachment to the tentacle, is long and flexible, highly contractile, transparent and colorless. The involucrum forms a button-like structure, not unlike an enlargement of the peduncle at its distal end. It is prolonged on one side into an apex, or

finger-like extension, at right angles to the axis of the knob.

The sacculus has thickened walls, and is a cylindrical body with a single turn, closely studded with nematocysts. In my notes I have written that the sacculus is colorless, but this would be such an unusual character for this structure, that it must be a mistake but refers to the involucrum.

The two terminal filaments are of medium length and arise on each side of the terminal vesicle. They are transparent, flexible, scattered with nematocysts, sometimes retracted into short, stumpy appendages.

The terminal vesicle is ovoid, thin walled, colorless and has a few nematocysts.

The sexual bells, male and female, of *A. Californica* were undeveloped. From this fact, as well as the small size of the specimen, I am led to regard this as the young or larval form, and that the adult was not seen by me.

The genus Athorybia is a most interesting one in our studies of the phylogeny of the Physophores. Especially is this true of those forms related to Athorybia in which we have but a single polypite, for they closely resemble the young of such genera as Agalma, while several other details of anatomy, which seem to characterize the adult Athorybia, are found also in the larval Agalma.

It is, of course, not impossible that the form *A. Californica* is the young of a species, more like *Diplorybia formosa*, and it may be true that all monogastric Athorybia-like genera are larval forms of polygastric Anthophysidæ.

SPHÆRONECTES GIGANTEA gen. et sp. nov.

Up to the present time this interesting Calycophore has not been found in American waters on the Atlantic or Pacific coast. I have taken what may be its diphyozooid at Newport, R. I. This diphyozooid of Sphæronectes is fig-

ured in my notice of certain medusæ from Narragansett Bay as *Diplophysa inermis*, a name under which it is described by Gegenbaur and others. The adult Sphæronectes, however, has never been reported from the Atlantic coast, although it is well known from the Mediterranean.

In an evening's fishing at Santa Cruz I captured several specimens of a gigantic Sphæronectes, which is so different from that from Villa Franca, which I have often collected, that I have no hesitancy in declaring the Californian representation to be a new and undescribed species.

There is in Sphæronectes (Monophyes) but a single nectocalyx, and in this respect it differs from most other known Calycophores. This nectocalyx in *S. gigantea* is almost a half-inch in diameter and is globular, slightly flattened on one side, where the entrance into its cavity lies. This entrance is partially closed by a thin velum. The cavity of the bell is shallow. The walls of the nectocalyx are thick, especially at its apex. In this thickened part of the nectocalyx, there lies a groove or depression, out of which hangs the stem. The somatocyst, a blindly ending tube, in communication with the point of junction of the stem with the bell at the fundus of the depression, extends parallel to the radial tubes of the nectocalyx in the thick gelatinous walls of the bell. The somatocyst is filled with "spongy cells" as in Diphyes.

The axis of *S. gigantea*[1] is small and short, and can be wholly retracted into the groove of the nectocalyx. When extended, it was several times the diameter of the nectocalyx in length.

All the diphyozooids upon the stem were immature, which fact leads me to think that the specimens which I had were young, and that the adult has a nectocalyx larger than that of any known Sphæronectes.

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[1] The name *gigantea* is suggested for this species.

CHRYSAORA MELANASTER Brandt.

This beautiful medusa was taken off the lighthouse at Santa Cruz. The specimen differs somewhat from the description by Brandt, whence it has seemed well to give a new diagnosis. The umbrella is flat, disk-shaped, the diameter being about double the height. Color, reddish-brown; thirty-two marginal lappets are found on the border of the bell. The surface of the bell has brown radial lines, extending from the center to the periphery of the disk. The marginal lappets have a rectangular shape.

There are eight hooded otocysts. The surface of the bell above the otocyst is swollen into a rounded prominence in the center of which there is a conical pit, or "Riechgrübchen."[1] The otocyst has a bright yellow and brown color. Between each pair of otocysts there are three marginal tentacles. There are therefore twenty-four tentacles in all on the rim of the umbrella. Each tentacle is more highly colored than the bell, and their tips especially have a brighter red color. Tentacles are unbranched, long and simple, with many nematocysts.

The lower floor or sub-umbrella of the bell has a whitish color. The actinostome hangs from the sub-umbrella by four pillars which are transparent. The structure of the mouth is like that of *C. Mediterranea* Per. et Les.

The specimen which I had was younger than that so beautifully figured by Mertens, which may account for the fact that the shape of the marginal lappets is very different. In addition to a single specimen collected by myself, the Santa Cruz fishermen brought me one or two broken examples of others collected from the Bay of Monterey. At certain times of the year the genus appears to be very common, but

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[1] Possibly a special sense organ.

during my stay at Santa Barbara and Monterey, they were rare and were seldom seen.

AURELIA LABIATA Cham. et Eys.

(PLATE V, FIG. 2.)

The Pacific Aurelia is readily distinguished from the Atlantic species, found from Greenland to Newport, by the pinkish color of the umbrella, while the specimens which were found are much smaller than those of *A. flavidula*. The largest specimen seen was about sixteen inches in diameter. I am, however, told by fishermen that in the summer months much larger specimens occur. There is no doubt that the species is a characteristic one, but with the exception of the above differences and a few others, it closely resembles our common eastern species. The eye spots appear browner than those of *flavidula* and the pyramidal extension of the bell in the stomach is not so marked. This latter character may, however, be a consequence of the diminutive size of the specimen, for in the young of *flavidula* this structure is wholly wanting.

I found several specimens of Aurelia in the Bay of Monterey and one near Point Conception.

Several of the former specimens were found to be infested by a Hyperia, as is also the case with *A. flavidula*.

PELAGIA PANOPYRA Per. et Les.

(PLATE V, FIG. 1.)

The common large Pelagia from southern California (Santa Barbara) is supposed to be the same as *P. panopyra*. The other species of Pacific Pelagias, which have been described, are *P. denticulata* Brandt, and *P. flaveola* Esch. From both of these it differs in this, that while the mouth arms of both *denticulata* and *flaveola* are very short,

as compared with the diameter of the bell, those of *panopyra* are very long. As for the most part we have nothing but figures to guide in the determination of the different species of Pacific Pelagias, a short description of the Pelagia found by me is here given.

Bell hemispherical or flat, rounded, flattened at the apex. The diameter of the bell is about double its height. Nematocysts strewn in clusters over the outer surface. Color pinkish. Color of cluster of nematocysts, white. Marginal lobes, pointed or rounded, one between each tentacle and otocyst, making in all eight long, flat, dark red tentacles. Eight hooded sense-bodies alternating with the tentacles. The sense-bodies are bright orange in color.

The oral arms, four in number, are long and slender, several times the diameter of the bell. Surface covered with nematocysts, and lips furnished with fimbriated edges. Color pinkish. The specimen which is represented (Plate v, fig. 1) has a bell eight inches in diameter. The oral arms of this specimen when extended were three feet in length. Another specimen had oral arms *six feet* long. The tentacles are much longer than the oral arms, and have a bright red color while the bell and oral arms are pinkish. The marginal sense-bodies are bright orange. The specimens were found in the Santa Barbara Channel off Santa Cruz Island.

Pelagia panopyra has thus far been described from the tropical regions of the Pacific and from Australia in the South Sea. Our knowledge of it has been built up for the most part from Lesson's figure. Of this figure, Agassiz says, "Nothing can be worse than the figures of this acaleph published by Lesson." Special descriptions and figures have also been published by Eschscholtz and Brandt. Peron and Leseuer have also given a figure, and Haeckel has brought together in a collated form what is known of

the species. My specimens agree in the two most important features regarded by Haeckel as characteristic, viz. : a thin walled umbrella and very long slender mouth tube.

ACTINOZOA.

Bunodes Californica sp. nov.

(PLATE VI, FIGS. 5, 6.)

This species is the most common Actinozoan at Santa Barbara. It forms colonies upon the rocks even left bare at low tide, and has a habit of covering itself with small stones or bits of shell so that such a colony on the rocks resembles an encrustation of pebbles.[1] These colonies protected by their sandy covering are exposed for an hour or more to the burning rays of the sun and are found oftentimes six or seven feet from low-water mark. The different members of the colony are closely huddled together, and when contracted, as they necessarily are when in such masses, could readily be mistaken for numbers of Ascidians. The majority of the specimens are about the size of a silver half dollar, but large examples were found several inches in diameter. The sand covering the body is found most abundantly on the oral pole of the animal on the external walls. This is really the only exposed portion, the individuals are so closely crowded together. Bunodes clings voluntarily to the bits of sand which forms its coat-

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[1] *Zoanthus socialis* has this same habit of covering itself with small foreign bodies, sand and fragments of shell. It is supposed that the members of the colony grasp the grains of sand when in mechanical suspension in the sea water. Several genera and species of Actiniaria have the same habit, but I have never seen it as well marked as in *B. Californica.* McMurrich (Journal of Morphology, Vol. III, No. 1, pp. 65, 66) describes in a new species of Gemmaria, *G. isolata*, enclosures of sand and other foreign bodies in the "Mesoglœa."

Students of the Hydromedusæ following McCrady's suggestion use the term Gemmaria for a genus of Medusæ. It might be better to adopt another name for the Actiniarian genus, Gemmaria of Duchassaing and Michelotti; still there is something to be said in support of the use of the name for the Actinian.

ing, and when a foreign object as the end of a pencil be placed upon that region of the body where the knobs are thickest, it is quickly caught hold of and retained by these structures. The region of the object immediately around the circle of tentacles is thickly set with these knobs which here appear to have the form of immature tentacles, and may be homologous with these structures. The object of the Actinian in covering itself with pebbles and bits of shells may be protection.

This species is closely related to *Bunodes papillosa* Verr., figured by Lesson in the "Voyage Coquille," Pl. III, fig. 2. It also resembles *B. pluvia* Verr. (see Notes on Radiata, Trans. Conn. Acad., Vol. I, p. 468. It is closely allied to Urticina of Ehrenberg in the greater or less irregularity in the arrangement of the tubercles. The descriptions of our West Coast Actiniaria often unaccompanied by figures are often perplexing, and the diagnosis of the species not all that might be wished for. While my name is probably a synonym, the characters of the species are somewhat different from those recorded for other forms of Bunodes.

The species is also related to *B. Sabelloides* And.

The following description of the soft parts of the body may give some idea of its general external form.

Body column cylindrical, with thick opaque leathery walls crossed externally by vertical lines of tubercles in indistinct rings. These knobs increase in numbers about the oral disk. When the oral disk is fully expanded the knobs in this region are closely crowded together and resemble immature tentacles. Margin tuberculate. Color of body uniform yellow and green. Rows of knobs pale chocolate or brown. No acontia observed. No cyclides. Tentacles simple, stumpy, arranged in many rows, entac-

mæous. When expanded, their tips extend about double the diameter of the body. Radial lines of the septa, on the perioral region, appear as silvery, double lines, extending from the mouth to the tentacles. Small simple mouth, with slightly raised perioral prominence. Mouth has the form of a longitudinal slit. Body adherent, tentacles wholly retractile. Sphincter muscle strong. The genus lives in colonies covering rocks which are bare at low tide. Whole colonies are hidden by coating of small shells and gravel, and seem to retain considerable water from one tide to another in their body walls.

Found abundantly on the rocks at Point Castillo. Magnificent specimens of this Bunodes, ten inches in diameter, were found on the island of Santa Cruz. The tentacles are a beautiful green and yellow color. In these specimens the tubercles situated about the ring of tentacles formed a thickly crowded zone on the body, and have a dull yellowish or brownish color. Like the specimens from the rocks of Punta del Castillo these Bunodes likewise collect foreign bodies upon the knobs, but in places where there is little sand these aggregations are for the most part pieces of shells and fragments of seaweeds.

Large numbers of the young of all sizes occur at the bases of the older specimens, and evidences of fission can be readily seen. That the colony is formed in that way and by gemmation from the base seems to be doubtless true.[1]

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[1] M. Nussbaum gives a very short account of fission in an unknown Actinia from the coast of California. This may possibly be the same genus as that which I call Bunodes, but there is nothing to prove that such is the case as his notice is so imperfect that the animal studied cannot be identified. I have often taken Bunodes with young clustered at the base, and the form of the colony would indicate that this mode of reproduction is very common. (See Nussbaum, Vorläufiger Bericht über die Ergebnisse einer mit Unterstützung der Königlichen Akademie ausgeführten Reise nach Californien. Sitz. der Kön. Akad. der Wiss. zu Berlin, 1887, Nos. L, LI.)

ANEMONIA STIMPSONII sp. nov. (?).

(PLATE VI, FIGS. 3, 4.)

Among the many Actiniaria which people the waters of Santa Barbara[1] one of the most beautiful is a species of Anemonia to which is given the specific name *Stimpsonii* out of profound respect to the memory of one of our best students of marine animals, Dr. William Stimpson. This anemone was found abundant in the pools and reefs of Santa Cruz island, where it was first seen, but it was also collected at various points on the main land.

A. Stimpsonii is a small Actinian of bright red color, with blood-red crimson stripes on the smooth body, especially on the region of the external body wall near its attachment. When the tentacles are retracted they are wholly hidden, and the body forms a wart-like structure on the base of attachment, not unlike a Metridium, but of bright crimson color. When expanded the margin of the circumoral region is reflexed, by which the tentacles are widely expanded.

The tentacles are brownish in color, stumpy, without lateral appendages, and armed with powerful lasso-cells.

The region between the single row of tentacles and the mouth is smooth, destitute of appendages. The ring about the mouth has a whitish color. The mouth is circular, slightly linear. The base of the tentacles is whitish with a white spot at the tips. Tentacles, smooth, menocyclic. The whitish spots at the bases of the tentacles are conspicuous.

When the polyp is wholly expanded the upper region of the body immediately contiguous to the base of the ten-

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[1] Santa Barbara lies between the region from which most of the specimens of west coast Echinoderms recorded by Verrill (Trans. Conn. Acad., Vol. I, part II, No. 2) and those of Stimpson (*op. cit.*) were taken. It therefore presents an interesting collecting ground for this group, and affords interesting facts in the study of the geographical distribution of west coast Echinoderms.

tacle forms a marked ferrule, separated from the remainder of the body by a shallow constriction. Specimens of the same genus, apparently the same species but of a yellow color, were found.

This Actiniarian is so different from any of those described from the west coast that I have ventured to regard it a new species.

ECHINODERMATA.

DERMASTERIAS IMBRICATA St.

The following facts may be added to those already recorded in regard to this starfish. It has been described and figured by others, but in none of the published accounts has reference been made to its coloration. The genus is one of the most brilliantly colored of the group.

The external surface body is leathery, and when seen from above is soft and destitute of spines. The color of the abactinal region is bright orange and red; on the actinal side the body is white or brown, slightly cream colored. There is a single row of feet on each side of the water tube on the actinal surface of the arm. The size of large specimens is eight inches in diameter. Anus central or subcentral. There is a single bright yellow madreporic body.

Dried specimens of Dermasterias show the marginal plates, like those of Astropecten, very conspicuously. These plates are, however, hidden in the live specimens by the thick leathery dermal covering. Claus's description of a species from the Red Sea has the plates much more prominent than the living *D. imbricata*, and corresponds with a dried specimen of the same.

The soft skin stretched over the calcareous plates and the absence of spines on the aboral surface of the body give a most exceptional appearance to the genus. When

the animal is alive the plates are not visible, but when dried these structures are plainly brought out. This genus is one of the most highly colored of all the Asteroidea in Californian waters, and the contrast between the colors of the upper and lower surface is very marked.[1] The very bright red and orange specimens of Dermasterias are female, while the male is dark brown. The ova have a yellow color.

In connection with the above description it may be of interest to record the colors of *Asterias*[2] *exquisita*. The abactinal surface is brown, with white knobs or rounded spines which are very conspicuous. Each knob is surrounded by a circle of purple colored, filamentous, tentacular bodies which are almost black.

The starfish, *Hymenaster miniatus*, which is very common at Santa Cruz, was often observed to be infested by a parasitic worm which from its intimate association is thought to be parasitic upon the external surface of its body.

Ophiothrix rudis Lyman.

Balfour records that the gastrula cavity, archenteron, of a species of Ophiothrix which he studied is formed by invagination. Apostolides says that this structure in another species is formed by delamination.

The archenteron of *Ophiothrix rudis* is formed by invagination. The following observations support this statement.

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[1]The genus Dermasterias is so markedly different from other Asteroidea that a new family is needed for its reception. I suggest the name Dermasteridæ with the following characters.

Arms five, covered with a thick, soft, leathery skin. No spines. Single row of suckerless feet. Mouth as in Astropecten. Marginal plates smooth, prominent. Dorsal plates of uniform size; no marked median dorsal.

[2]The differences of this species from other known members of the genus Asterias are great enough to separate it and to form a new genus for which the name Calliasterias is suggested.

Male and female organs are found in different individuals. The ovaries are orange colored; the spermaries, white or cream colored. Artificial fecundation was accomplished by methods similar to those already described in my paper on the development of Echinarachnius. Sexual organs are capable of fertilization in the month of March.

The ovum of Ophiothrix has a central, more opaque and a peripheral transparent zona radiata, as in Ophiopholis. Eggs fertilized at 12 M. passed into a four-celled stage at 8 P.M. and into a ciliated gastrula at 9 A. M. of the following day. All the successive stages in the infolding of the blastoderm to form the gastrula were observed and they were found to closely resemble those which I have elsewhere figured for Ophiopholis. My observations support those of Balfour and do not agree with those of Apostolides.

ANNELIDA.

Sabellaria Californica sp. nov.

(PLATE VII, FIGS. 3, 4.)

The inroads of the sea have worn the soft rock of Punta del Castillo into caverns on the roof of which many honeycomb-like formations of sand and fragments of shell are found. This incrustation, bare at low tide, forms in places a continuous mass several feet across and from a foot to two feet in thickness. It is a solid aggregation of worm tubes, the openings of which are found to be closed by the conical operculum of a Sabellaria. A fragment of this incrustation is represented on Plate VII, fig. 3.

The mass is easily crushed, is very fragile, and composed of particles of shells and grains of sand cemented loosely together. These worm tubes can be easily cut from the mass and the bodies of the Sabellaria readily ex-

tracted, for the aggregation is exposed for several hours between tides.

The body of the Sabellaria which forms these tubes is composed of two regions, a spiniferous anterior, and a non-spiniferous posterior body region. The anterior is segmented; the posterior unsegmented. Both are capable of great extension; the former being much thicker than the latter, which resembles somewhat an appendage to the former.

The operculum is round, low conical, with black radial ridges. On its edges there is a marked coloration. It is mounted on a contracted base and when the worm is retracted the operculum effectually closes the openings of the worm cases.

On each side of the operculum there is a tuft of filaments which are the branchiæ. They are simple, unbranched, flexible, extensile appendages and have a purple color at their bases. They lie on the oral and lateral regions of the head.

The mouth bears on each side a bifid structure of somewhat crescentic shape, and is enclosed by three lips, an anterior and two lateral posterior.

The first body segment lies just below or behind the oral aperture, and bears a bundle of serrated spines. The second, third and fourth body segments are somewhat different from those which follow. They bear on each side a comb-like structure, on the ventral side of which there is a small prominence with serrated setæ, and on the dorsal a filamentous branchia. The first body segments bear the two clusters or clumps of spines of the mouth, and the two small filamentous appendages.

The fifth and following body segments support on either side a fin-like protuberance of rectangular shape, without comb-shaped structures. This fold has on its outer edge

elongated bodies. There is a projection with setæ and a ventral cirrus on the ventral side, and on the dorsal a pair of filamentous appendages on each segment.

The most distal from the head of all the segments of the larger region of the body has the rectangular lateral bodies reduced to spatulate appendages. Here also the dorsal appendages are smaller, and the tuft of setæ more conspicuous. These setæ are simple, unjointed, serrated spines.

The posterior region of the body is unjointed, non-spiniferous. The anus is terminal, surrounded by a colored zone or ring.

The operculum has the appearance of being morphologically formed of a consolidated crown of black chitinous spines, similar to the ordinary body spines. On my visit to England last summer I examined fragments of the worm tubes of *Sabellaria alveolata* and find them very different from the masses of tube-cases of *S. Californica*. The Atlantic *Sabellaria vulgaris* mentioned by Verrill is also very different.

The ova of *S. Californica* were observed to be deposited singly, not in clusters or strings. They are white and opaque and each ovum is peripherally surrounded by a transparent cortical covering.

Sabella Pacifica sp. nov.

(PLATE VII, FIGS. 1, 2.)

At many places on the cliffs at Punta del Castillo, at Santa Barbara, I found what seemed to be a compact greenish rock riddled with tubes of a worm belonging to the genus Sabella. At first this was regarded as the work of a species of boring annelid, but afterwards it was found that the clay and foreign matter had simply packed in about the worm tubes forming a solid rock-like mass.

The head of this Sabella is armed with club-shaped ten-

tacles, four on each side. In one or two instances there are more than four of these structures. Each tentacle when retracted is dark colored on the distal end and more transparent at its origin from the head. The first cephalic segment is prolonged into a rounded, more or less triangular flap. The tentacles are inserted one behind the other, and are penetrated by blood vessels in which a red fluid can be readily distinguished through the body walls.

The body tapers uniformly from anterior to posterior extremity, the terminal segments of the tail being much reduced in size. The anterior segments are brownish, transparent; the terminal segments are almost opaque. The blood vessels with highly colored red fluid are conspicuous through the body walls.

The spines are small and inconspicuous. They resemble those of *S. alveolata*, to which species *S. Californica* and *S. Pacifica* are closely allied.

Spio Californica sp. nov.

A Spio which is different from any described species occurs under the cliffs of Punta del Castillo at Santa Barbara.

The tubes of this worm resemble those of Sabellaria but differ from them in color, size and form of the openings. The edges of the orifices are sharper and the tubes themselves are more compact.

Head with two long tentacles. Each tentacle has on its anterior border a double ridge of pigment bodies which enclose a ciliated groove. These pigment bodies are mounted on papillæ and resemble rudimentary eye-spots.

The tentacle is folded or annulated, almost jointed, and transparent. The tentacles are inserted on the dorsal cephalic region and through them there runs a yellow colored vessel through which circulates a red blood or a similar fluid.

The dorsal medium cephalic region is prolonged forward

into a median unpaired appendage which forms the roof of the mouth and extends considerably beyond the anterior margin of the head. On the ventral side the mouth is enclosed by two labial lobes, one on each side, and a median posterior lip.

Four dorsal eye-spots of dark color are found on the head. At the base of the cephalic tentacles there are two clusters of small spines. In one of these clusters the spines are directed forward and are larger than in the other. Both clusters lie at the base of the tentacles. The parapodia of the body are arranged as follows. On the second, third and fourth body segments, counting from the head, we find a dorsal and ventral bundle of setæ, and a dorsal and a ventral cirrus. The ventral cirrus is smaller than the dorsal. In the fifth body segment there is a fan-shaped deeply embedded bundle of large spines in addition to the dorsal and ventral clusters.

The segments following the fifth have in place of the ventral spine a collection of large, stiff setæ projecting in a fan-shaped form. These are at least five in number, often more, and notched on one side at their free edges. Dorsal cirrus long, simple and of a yellow color. The terminal body-segment is bifid, and the anus is situated at its tip.

The digestive canal has a brown and yellow color and is easily seen through the body walls.

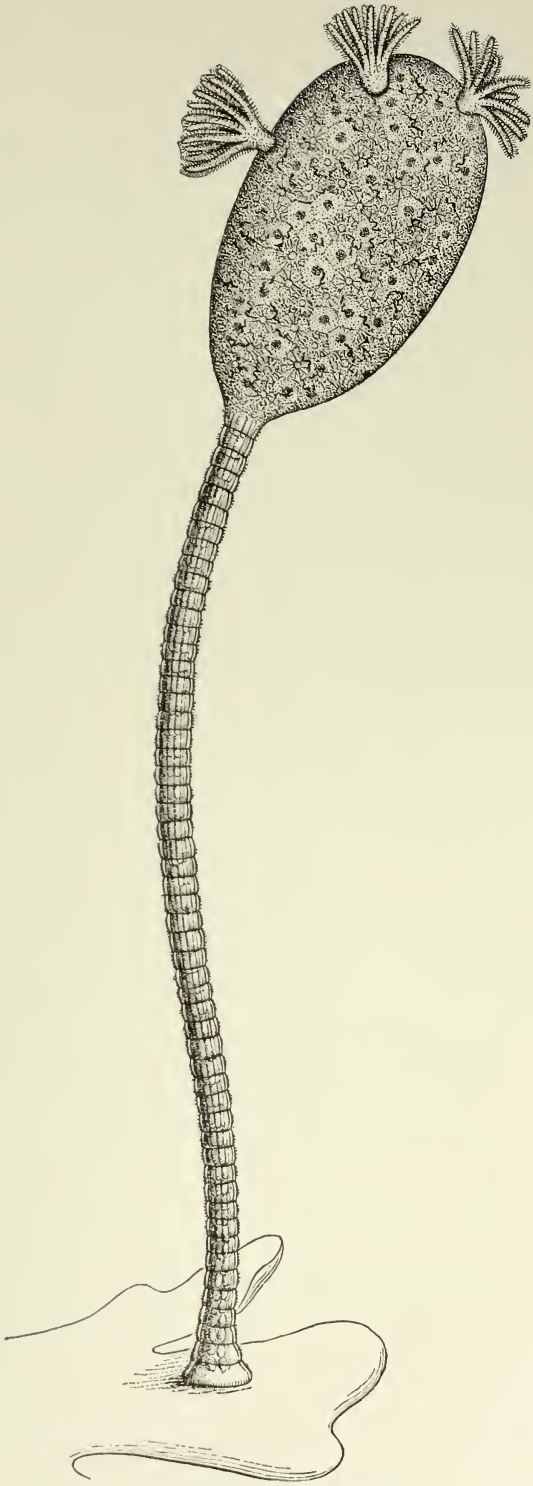
TUNICATA.

CLAVELLINOPSIS RUBRA gen. et sp. nov.

Specimens of this large red Tunicate are abundant on the piles of the wharf at Santa Barbara.[1] The animal is found in clusters, its leathery tunic being coated with many

[1] Many genera of free Tunicates were found in the Santa Barbara Channel. A large Oikopleura with its "*Haus*" is at times abundant. Doliolum was taken on

CLAVELLINOPSIS RUBRA Fewkes.



ASCORHIZA OCCIDENTALIS Fewkes.

low forms of life, Plumularidæ, Cirripeds, small Actinians and Tunicates.

The body is elongated, club-shaped, enlarged at the distal extremity and tapering to its attachment. Throughout its length it is furrowed on its outer surface by parallel creases or longitudinal indentations which impart a characteristic appearance to the external surface of the body. The color is a bright red, becoming darker along the stalk. The outer tunic is opaque.

The excurrent and incurrent openings into the tunic are terminal, arranged side by side on the upper extremity of the body.

Associated with Clavellinopsis many specimens of a beautiful Clavellina were also found.

BRYOZOA.

Ascorhiza occidentalis Fewkes.

This strange Bryozoan was dredged in twenty fathoms from the channel between Santa Barbara and Santa Cruz.

The body consists of an ovate capitulum[1] mounted on a slender, flexible, sensitive stalk. When this stem was irritated it was observed to sway slowly backward and forward, and even to quickly double itself forming a coil.

The whole animal is an inch in height, and its color is a

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two excursions. A large Salpa, resembling in size and shape *S. maxima* of the Mediterranean, was collected under the lofty cliffs of Santa Cruz Island. The solitary form of this Salpa is over four inches long.

[1]Mr. R. Kirkpatrick, to whom I am indebted for many valuable suggestions in regard to the structure of Ascorhiza has suggested the term "capitulum" to designate the compound zoœcium of this genus.

uniform dark brown throughout.[1] The capitulum is ovate, fastened to the stem at one pole of an axis passing through the longest diameter which is ordinarily carried upright. The external surface is covered with small warts, in places quite smooth, but there are no elevations to denote the position of the polypides. In confinement the polypides did not readily extend themselves, and the openings through which they protrude were difficult to discover. The wall of the capitulum is tough and translucent, while through it a ramifying system of delicate pink fibers extends. There are also many clusters of small yellow pigment spots in its substance.

The polypides were studied by a dissection of the capitulum. After many trials in which it was impossible to see these bodies extended, longitudinal incisions were made with the scalpel through the outer wall of the capitulum into the interior, where the polypides were found to be retracted. They lived for some time after this rough treatment of the capitulum. Each of the numerous polypides has an extended, saccular body fastened at one end and extended at the free extremity into a circle of tentacles. The polypides are confined to the capitulum, and in no case were they found expanded in the living animal.

Each polypide has a white, transparent outer wall, with yellow-brown colored stomach. At the base of the stomach there is seen through the body wall a globular mass. The mouth opening is uncovered and entire. The tentacles which are long, stiff and non-contractile, are readily moved

[1]The color closely approximates that of the giant kelp, Nereocystes, for which it was at first mistaken. The animal was found attached to the base of one of these algæ which rendered the likeness even more striking.

Numerous genera of Bryozoa people the Santa Barbara Channel. One of the most interesting of these is an Idmonea (Pl. VI, fig. 1) which is found in clumps sometimes as large as a man's head, and called by the fishermen a "coral." A Salicornaria is abundant all the way from the Bay of San Francisco to San Diego,

in all directions, but more especially centrifugally and centripetally. Their motion is very rapid, and they often twist themselves in a single coil. Their mode of movement is similar to that of other Bryozoa and markedly different from that of the hydroids. Their external surface is richly ciliated.

Many wheel-like structures were observed through the outer body walls of the capitulum. These bodies bear a close likeness to immature polypides with the undeveloped tentacles retracted giving them a radiated appearance, their tips being folded inward. The wheel-like structures are often pressed together and are most numerous near the lower pole of the capitulum at its point of union with the stalk. The more developed polypides thus lie at the distal pole of the capitulum.

The stem or stalk has a somewhat exceptional anatomical structure. It is a long, jointed body fastened at one extremity to some foreign body, and supporting the capitulum or colonial body of the animal. Its wall has a tough leathery character and is of the same color as the capitulum. The stalk is composed of a number of segments, externally indicated by ferrules of uniform size with the indentations well marked.

The stem is flexible and may be so bent as to bring the capitulum to the level of attachment of the stem, forming a bow. It is sensitive and quickly responds when pinched or otherwise irritated. The motion is slow and graceful. The stem is without appendages or lateral branches; the joints are of uniform size, with the exception of the basal, which is slightly expanded. The division of the joints is superficial.

The outer layer of the stem is translucent, pale brown or dark amber colored. A system of muscular blocks which near the capitulum become spherical can be seen through

the outer wall of the stem in the interior. These muscular blocks do not always correspond in dimensions with the size of the separate nodes externally indicated by constrictions in the stem.

What are the zoological affinities of Ascorhiza among Bryozoa?

The character of the carnose capitulum, in which the polypides are wholly drawn out of sight, recalls the genus Alcyonidium. No known ctenostomatous genus has a stalk like that of Ascorhiza and none of the genera allied to Alcyonidium have this structure.

From the entoproctous genera Pedicellina, Loxosoma and Urnatella which have a pedunculated habit, Ascorhiza differs in the character of the capitulum. We find a homologue of this structure in the last mentioned genus, the fresh-water Bryozoan described by Dr. Leidy. The capitulum is thought to be homologous with the "polyp-head" of Urnatella, for if we suppose this structure to be greatly enlarged and consolidated we have a structure almost identical with the capitulum. The stem of Urnatella, as so beautifully figured by Leidy, resembles that of Ascorhiza in many particulars.

While, however, Ascorhiza differs from all known entoproctous Bryozoa in the colonial form of the capitulum, the stem is found in several entoproctous genera, but nowhere does the likeness appear to be so close as in the genus Urnatella.

In Ascopodaria likewise we have, as figured in the report on the "Challenger" Bryozoa by Busk, at the base of a peduncle a barrel-shaped body which in some particulars resembles the jointed stem of Ascorhiza. This structure in Ascopodaria forms a cup-shaped socket from which the stem arises and which lies at the very base of the peduncle. Other resemblances between the two genera

are not close, for while one has a colonial capitulum the other has but a single polypide to each stem.

A possible interpretation of the combination of structural features which we have in Ascorhiza is that the genus belongs to the Ctenostomata somewhere near Alcyonidium, but that it possesses a sensitive, flexible jointed stem, a feature very rare in this group. It seems probable also that this stem is homologous to the stalk of Urnatella, a fresh-water genus, and more distantly related to a barrel-shaped structure at the base of the peduncle of Ascopodaria. If these comparisons are borne out by more intimate knowledge of Ascorhiza and it is found that there is a true homology between the structures in question it may be found that we have in Ascorhiza a genus connecting two great groups of Bryozoa to which the genera mentioned above belong. So characteristic are the structural peculiarities of Ascorhiza, and so different from any known genus, that it may be necessary to make a new family for its reception.

From my limited knowledge of the internal anatomy, especially of the relative positions of the oral and anal aperture, I am unable to discuss this important anatomical feature in my reference of the genus to Ctenostomata or Cheilostomata. The external features alone stamp it as different from any known genus of either group.

NUDIBRANCHIATA.

CABRILLA gen. nov.

At the time of my visit to Santa Cruz Island, the anchor of a buoy in Prisoner's Harbor was pulled up and with it came a new genus of Nudibranchs for which the name Cabrilla is suggested.[1]

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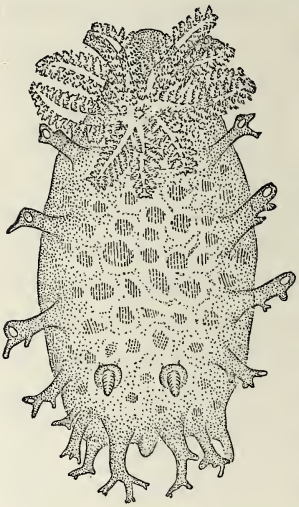
[1] From Cabrillo, the intrepid discoverer of the Santa Barbara Islands.

CABRILLA OCCIDENTALIS gen. et sp. nov.

The body is irregularly globular, elongated, depressed above and of greenish-brown color. It is covered with light-green spots. The dorsal appendages are biserial, one on each side of a median line as in Triopa. These appendages are stumpy, slightly dendritic, bearing lens-like bodies at their tips. Four of these appendages are larger than the remaining and more laterally placed. The remainder are more dendritic and anterior. Two pairs of dendritic appendages are found behind the branchiæ.



There are two dorsal tentacles, one on each side of the medial line. These appendages are conical, linear or subclavate and brown at their tips, which can be readily retracted. The branchiæ are stellate, bipinnate, consisting of primary arms and lateral branches, of white color, transparent. These branchial plumes are situated near the posterior end of the body.

Foot disk-like, and of a brownish-green color. The body is *four* inches in length.

Cabrilla resembles Triopa of Johnston, but is most closely allied to Plocomorphorus of Rüppel.

The lateral appendages are slightly dendritic, as in Dendronotus, but unlike this genus there are branchial plumes. Triopa has but three branchial plumes and is smaller than Cabrilla. Plocomorphorus has a cloakless, slug-like body, with expanded cephalic veil and lateral appendages, plumose branchiæ and two retractile tentacles. Cabrilla dif-

fers from *P. Ceylonicus* in the form of the cephalic veil, the square truncated anterior and bluntly rounded, posterior extremity.

Plocomorphorus has but four pairs of branched lateral appendages between the tentacles and the posterior end of the body — one pair of which lies between the plumose branchiæ and the tentacles — while Cabrilla has four pairs of lateral appendages between the branchiæ and the tentacles and a single *additional* pair *behind* the branchiæ. It has, therefore, *five* pairs in addition to those on the veil.

The lateral appendages of Plocomorphorus are not represented by Alder and Hancock,[1] as having structures corresponding to the highly retractile bodies at the tips of the lateral appendages of Cabrilla. These lens-shaped bodies have been observed by me in several genera and from their prominence it seems not unreasonable to regard them as highly important organs. They recall in their general appearance otoliths, and it seems possible that they are organs of special sense.

Chioræa leontina Gould.

(PLATE VI, FIG. 2.)

This Nudibranch described by Gould in the "Mollusca of the Wilkes Expedition" and again mentioned by Cooper[2] was collected at Monterey. My specimens closely resemble Gould's figures and descriptions and are much younger than his. Dr. Cooper describes the head of his specimens as "nearly conical" and "the branchial processes five on each side larger than represented in Gould's figure, imbricated and decumbent." The "head" of my specimens is unlike that of those described by Cooper from Santa Barbara, and is rounded like Gould's specimen from

[1] Indian Nudibranchiate Mollusca, Trans. Zool. Soc., London, Vol. v, 1866.
[2] Proc. Cal. Acad. Nat. Science, Vol. III, p. 60.

Puget Sound. The number of branchial appendages is the same as in Cooper's specimens and less than in those of Gould.[1]

Mr. A. Agassiz has kindly loaned me drawings of an unidentified Nudibranch taken by him in 1859 at Port Townsend, Washington Territory. One of these represents a side view (Pl. VI, fig. 2), another a dorsal and a third the head from below looking into the mouth. The last mentioned shows the two rings of cephalic tentacles and the slit-like character of the mouth in addition to the features already mentioned. From the resemblance of these figures to those given by Gould I had referred them to Chioræa.

The main anatomical features of Chioræa are given by Gould and Cooper, whose accounts differ only in subordinate particulars. In the main, my observations resemble theirs, only differing in details. No one has yet discussed the affinities of Chioræa with other genera, although new genera, closely akin to it, have been described. It may not be out of place to call attention to certain affinities of this rarely[2] mentioned animal. Its systematic position is near Melibe, of which we have a species *M. rosea* Rang, from the Cape of Good Hope, and *M. fimbriata* described by Alder and Hancock. Kalaart's species, *M. viridis*, seems different from either. It is more closely allied to Tethys which is not yet known to occur in the Pacific. Its remarkable differences from either Tethys or Melibe, entitle it to membership in a new family, the Chioræadæ, in which it stands alone, but if we follow Alder and Hancock's classification it would be an aberrant member of the Tethydæ.

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[1] Cooper justly suspects that this difference may arise from immaturity. Gould's specimens were five inches in length; Cooper's, two and three-fourths inches.

[2] This genus is not mentioned in several monographs of the Nudibranchs and its systematic position has remained hitherto undetermined.

EXPLANATION OF PLATES.

All the figures with one exception were drawn from nature by the author. The pen-and-ink reproductions are by Mr. S. F. Denton and the author. The original drawings were free-hand, and were often made under very unfavorable circumstances, on board ship, in temporary working places, or in the open air. All figures, unless otherwise indicated are very much enlarged.

The figure of *Chioræa leontina* (Pl. VI, fig. 2) was made by A. Agassiz, copied by Denton.

Plate I.

Fig. 1. *Velella Meridionalis* sp. nov. Probable not an adult, although from a specimen much larger than that shown in figs. 2, 3.

Fig. 2. The same seen from the under side. The central body of bright blue color is the "feeding polyp" and the small blue tentacle-like structures about it mark the limit of the "float" (see description) as seen from the lower side. The oval body forming that portion outside the float is the umbrella seen from below.

The umbrella also forms a conspicuous part of fig. 3, but from the fact that it is seen from the edge is not so conspicuous in fig. 1.

Fig. 3. Velella seen from above. The oval body forming the great mass of the animal is the umbrella as explained above. The smaller oval body placed diagonally on the larger is the float seen from above. In this float the concentric lines indicate the edges of the chambers which make up the float. The thin plate extending across the float is the triangular sail, shown from the side in fig. 2, and seen in perspective. This sail is much larger in the specimen figured in fig. 1, than in that shown in fig. 3. The upturned edge of the umbrella shown on the right of fig. 1 corresponds with the upper pole of fig. 3.

Plate II.

Fig. 1. *Athorybia Californica* sp. nov., side view, showing a single full grown polypite, tentacles (three are represented), tasters and covering scales. It will be noticed when compared with published figures of other Athorybiæ that the float is very prominent and that the mouth opening of the polypite is more trumpet-shaped than is ordinarily the case. This figure was a free-hand drawing made on shipboard. Later a better examination was made on land in which I detected but *one* tentacle. I am confident that in my first examination *three* tentacles were seen and so have reproduced my *original* drawing.

Fig. 2. A single tentacular knob of the above, showing the peduncle, the involucrum, two terminal and a single median tentacles or filaments. The median is inflated into the terminal median vesicle.

This figure also shows the sacculus. The knob closely resembles that of other Athorybiæ and differs from that of the young Agalma. A young Agalma of the same age would have those tentacular knobs which I have called "embryonic tentacular knobs" (see figures in Bull. Mus. Comp. Zool., Vol. VIII, No. 9).

The apical prolongation of the involucrum is a character of the genus Athorybia. This projection is shown on the lower side of the involucrum.

Fig. 3. View of *Velella Meridionalis* sp. nov. Seen from above looking down on the float. Compare with the colored figures of Plate I.

Plate III.

Fig. 1. *Steenstrupia occidentalis* sp. nov. Very much enlarged, showing budding young at the base of the single long tentacle.

Fig. 2. Young medusa of *Syncoryne* (*Sarsia*) *occidentalis* sp. nov.

Fig. 3. Adult of the same. Very much enlarged.

Plate iv.

Fig. 1. Head of the hydroid *Syncoryne rosaria* (A. Ag.). Showing budding medusæ among the tentacles. The figure is taken from one of the life-size specimens shown in fig. 4.

Fig. 2. Hydroid *Atractyloides formosa* sp. nov. The tentacles are half retracted. External wall covered with algæ. This figure is an enlarged view of one of the following.

Fig. 3. Cluster of the last-mentioned hydroid (life-size).

Fig. 4. Cluster of *S. rosaria* (life-size).

Fig. 5. Male capsule of Atractyloides. These clusters are found at the base of the hydranth stem arising from the branching basal tubes and not from the stem of the hydroid. The central dark body is the spadix, from the left-hand side of which a curved body, "spermatic mass"? is seen in process of formation.

Fig. 6. Very young Polyorchis before the lateral branches of the radial tubes form.

Fig. 7. Adult *Polyorchis penicillata* A. Ag.

Fig. 8. *Microcampana conica*, gen et sp. nov.

Plate v.

Fig. 1. *Pelagia panopyra*. Size reduced.

Fig. 2. *Aurelia* sp. incog.; possibly *A. labiata*.

Fig. 3. *Willia occidentalis* sp. nov.

Plate vi.

Fig. 1. *Idmonea* sp. nov.

Fig. 2. *Chiorœa leontina* Gould. From a drawing of a specimen taken by A. Agassiz at Port Townsend, W. T., in 1859.

Fig. 3. *Anemonia Stimpsonii* sp. nov. The tentacles are half retracted.

Fig. 4. The same with tentacles more retracted.

Fig. 5. *Bunodes Californica* sp. nov. The Actinian is rep-

resented as expanded with the oral disk turned towards the observer.

Fig. 6. The same partially contracted with oral disk turned from the observer (life-size).

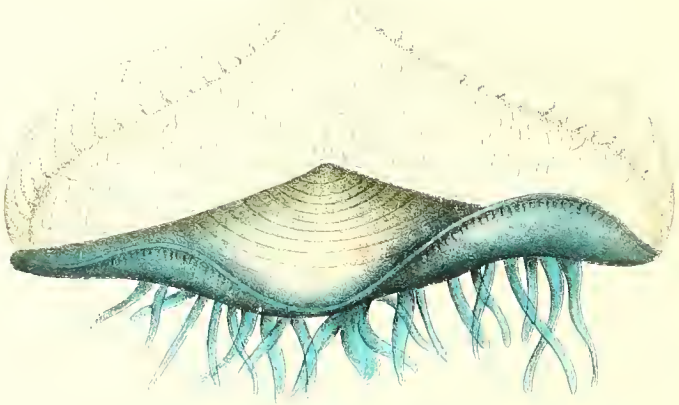
Plate vii.

Fig. 1. A rocky mass formed of the worm tubes of *Sabella Pacifica* cemented together. The section of this mass with the ramifying tubes appears in the foreground: the external tube openings on the smooth, upper side. The intervals between the tubes is filled up by a clay-like material semi-solidified. A pit is seen in the middle of the figure, from which protrude the edges of the shells of several small mussels which were alive when the mass was drawn and which have become embedded in the growing mass, hermetically imprisoned in this pit.

Fig. 2. *Sabella Pacifica* removed from the mass figured above.

Fig. 3. Portion of a large cluster of sand tubes of *Sabellaria Californica* sp. nov. This was cut from a mass four feet long and of about the same width and eighteen inches thick. The upper part shows the external openings, the lower foreground sections of the tubes. On either side the tubes are shown. The rounded bodies or disks shown closing several of the external orifices of the tubes are opercula of the inhabitant of the tube.

Fig. 4. *Sabellaria Californica* extracted from its tube. The dorsal region is on the lower side of the figure. The body is very much contracted, and the posterior end of the body is bent downward. Its position, when alive, is probably bent to the other side of the anterior end, the posterior opening being thus brought near the operculum.



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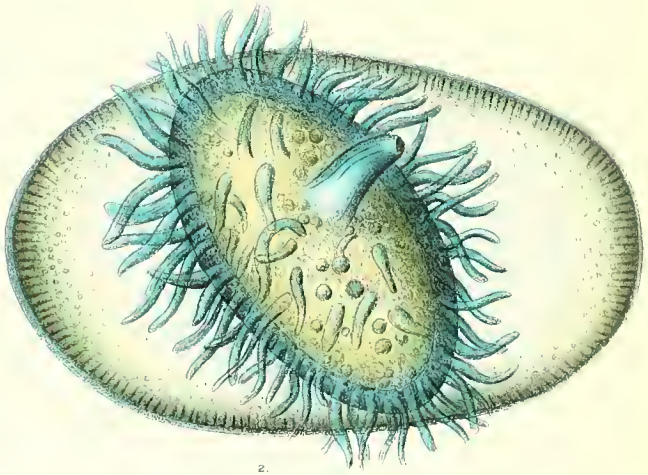

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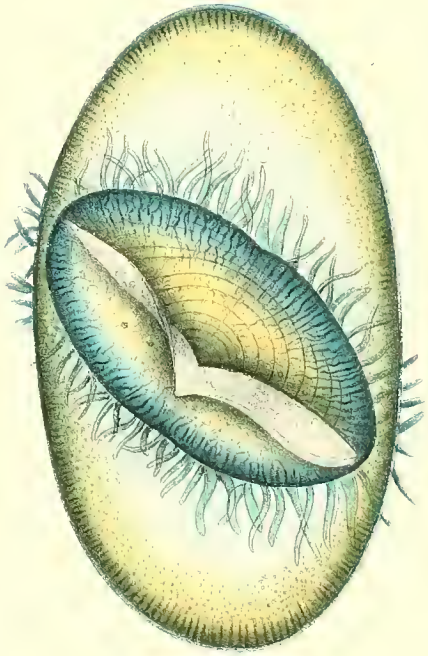

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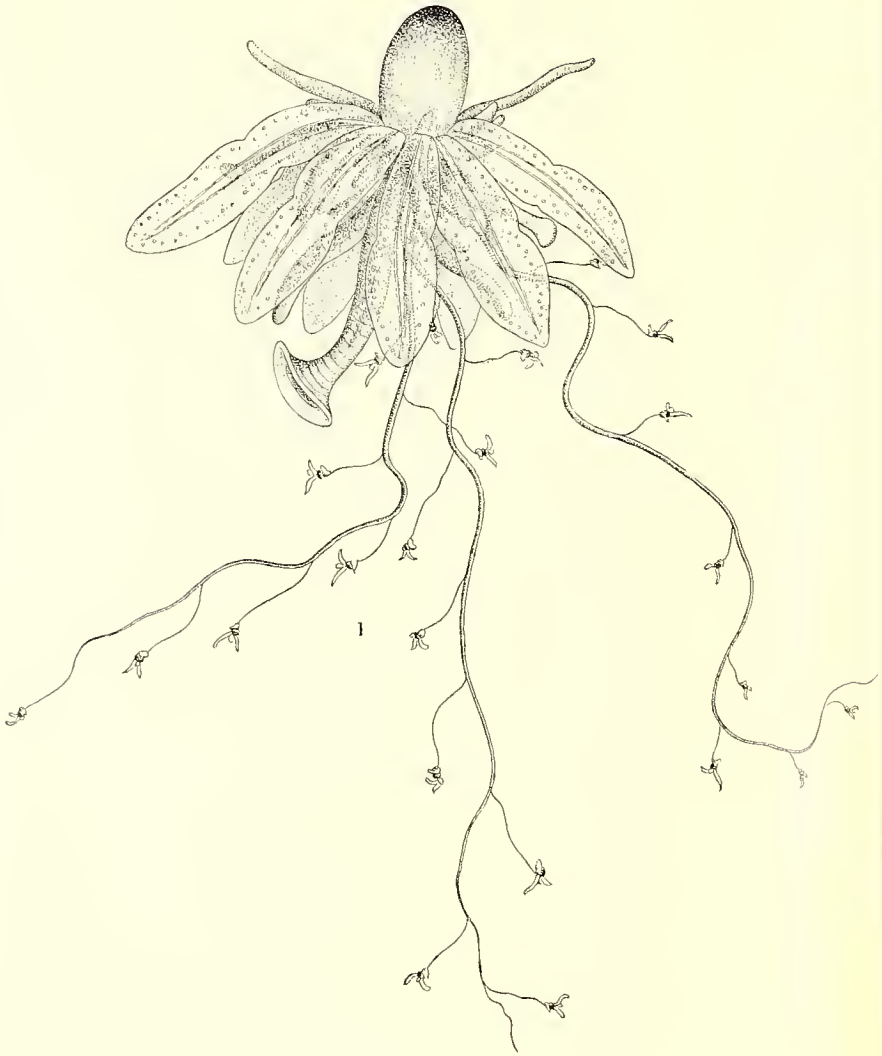
J. W. Fewkes del. J. Mosel lith.



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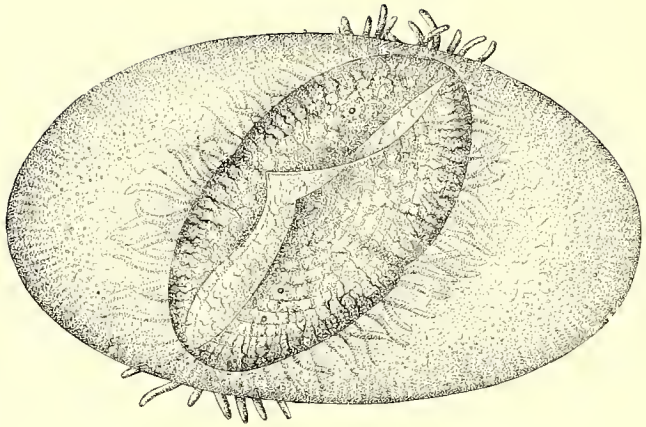

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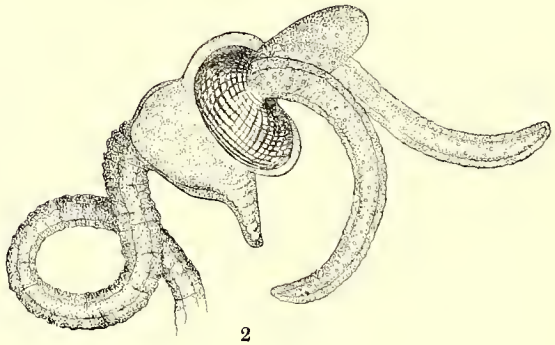

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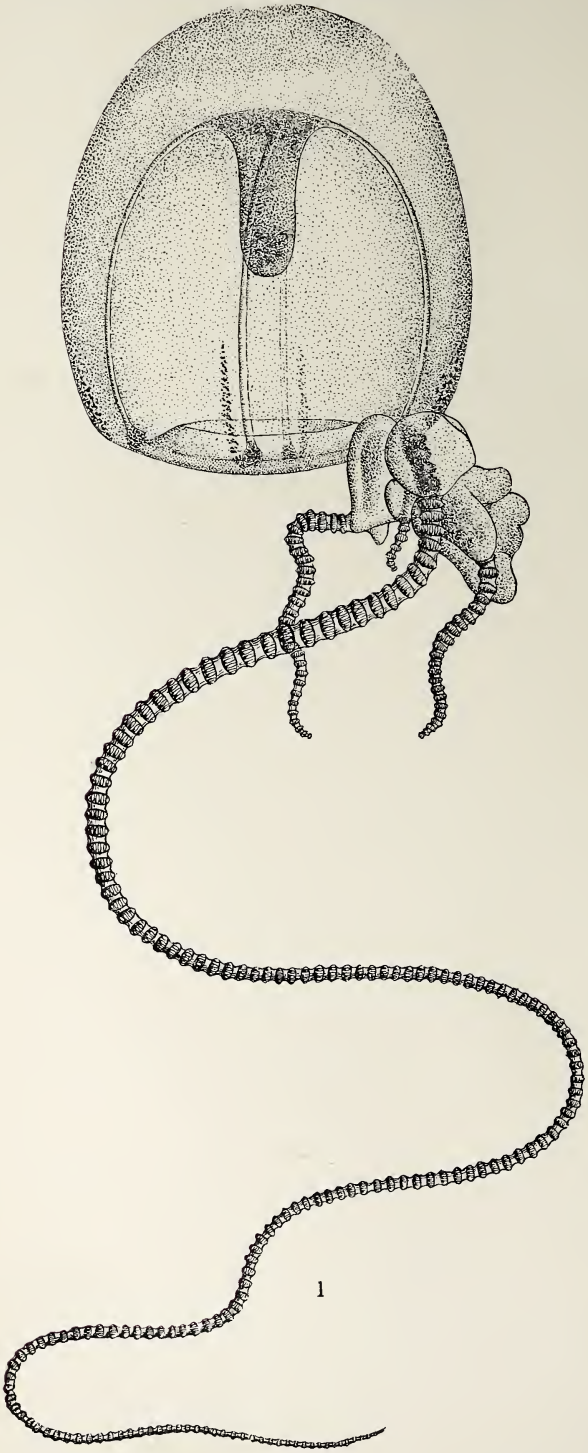

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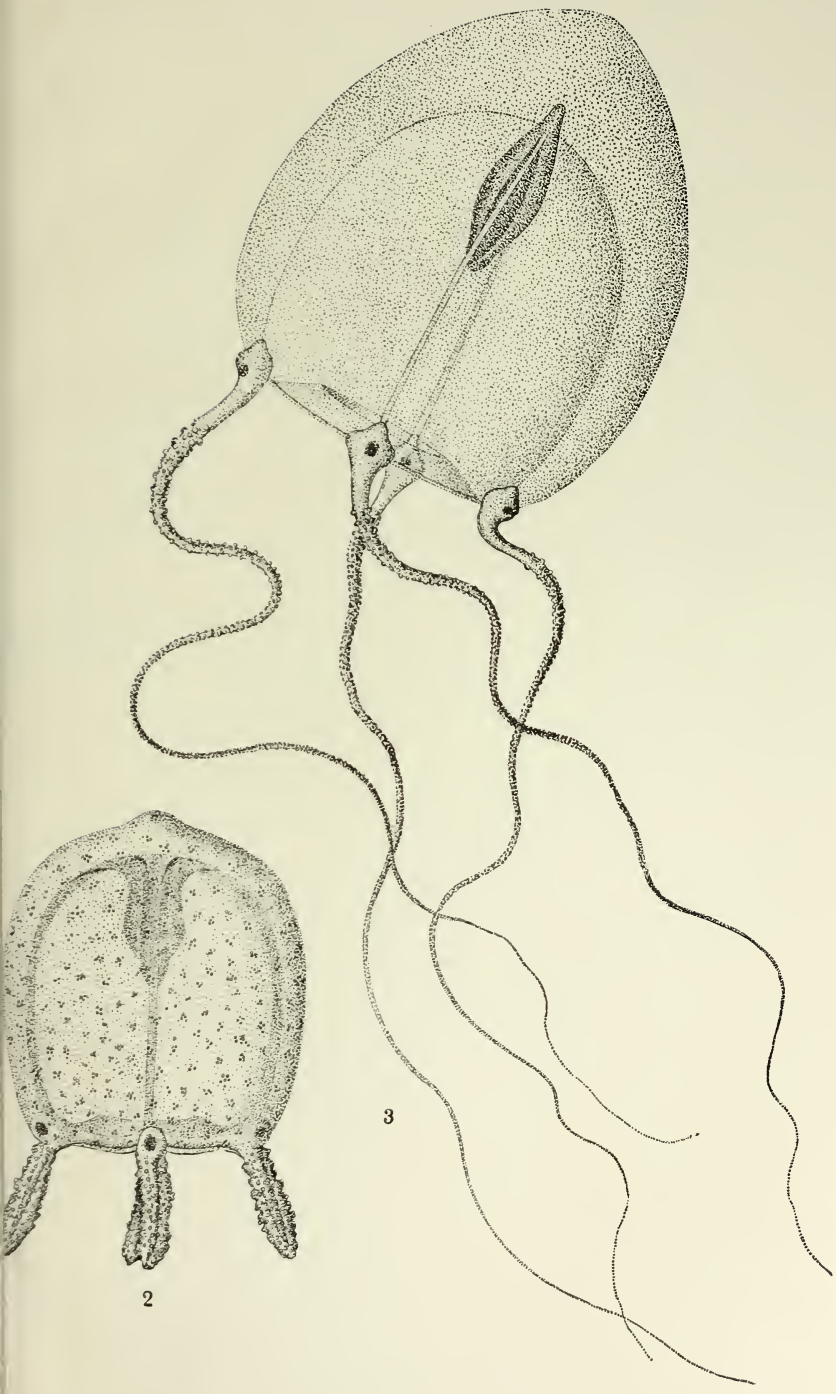
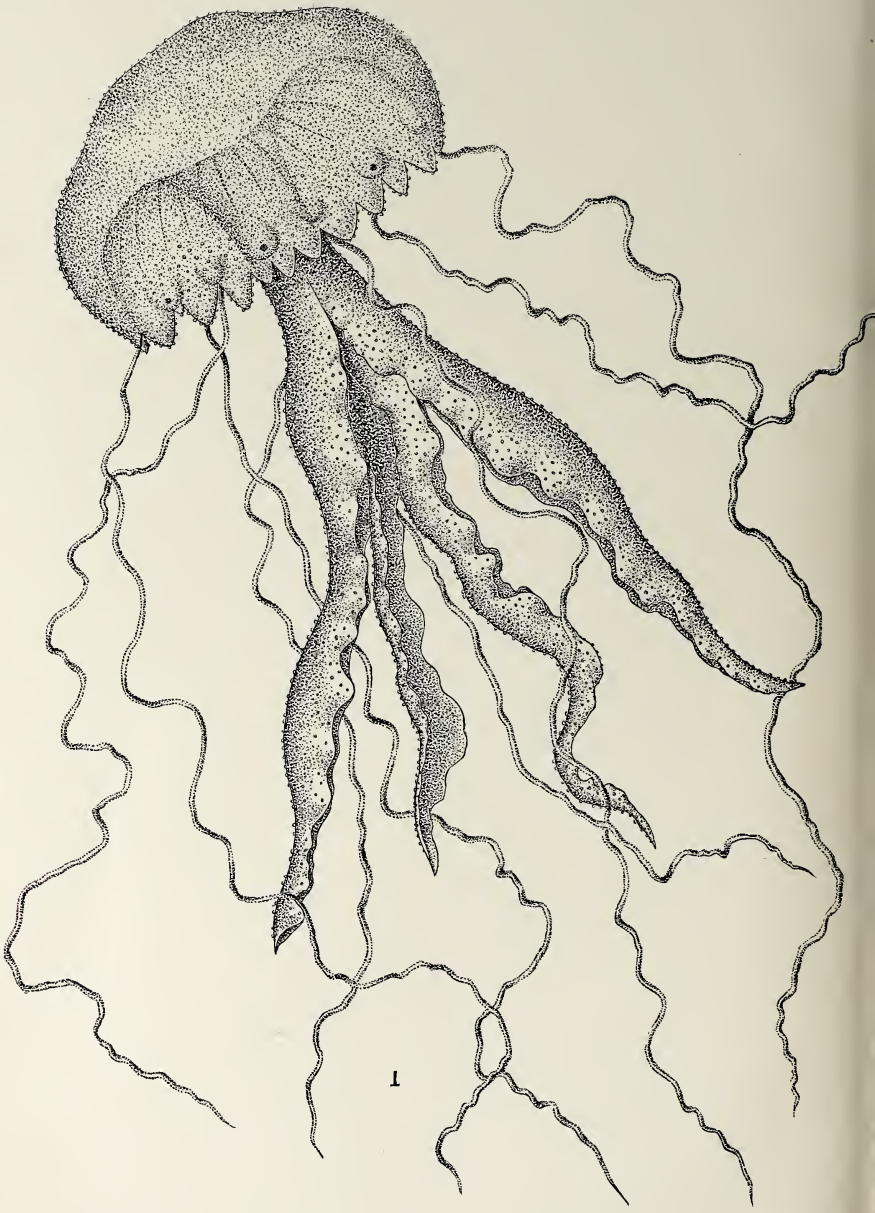
PLATE III.





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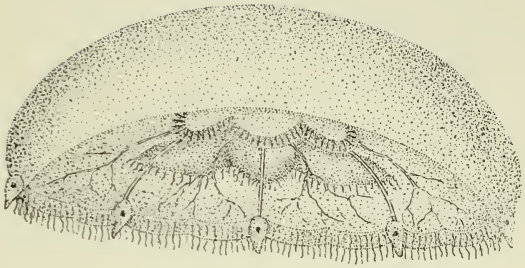

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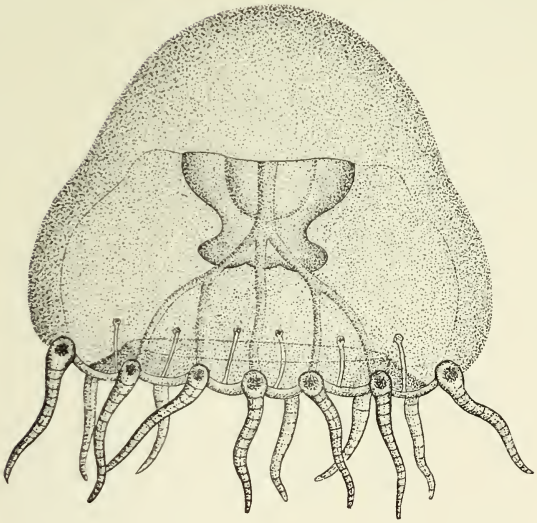

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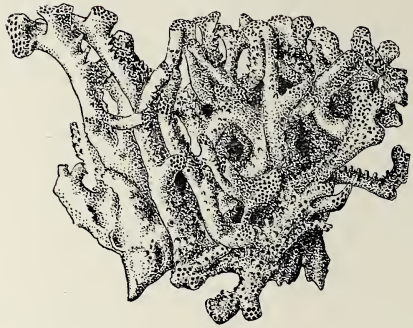

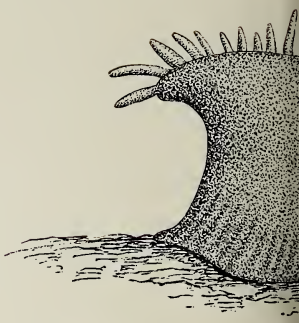

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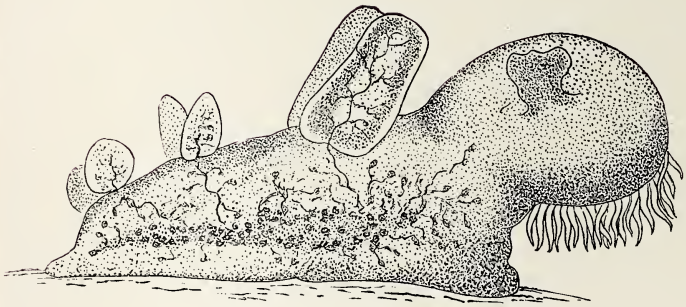

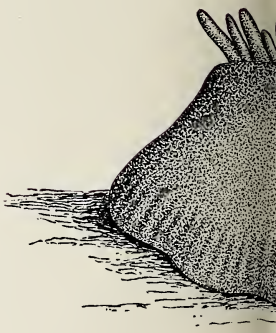

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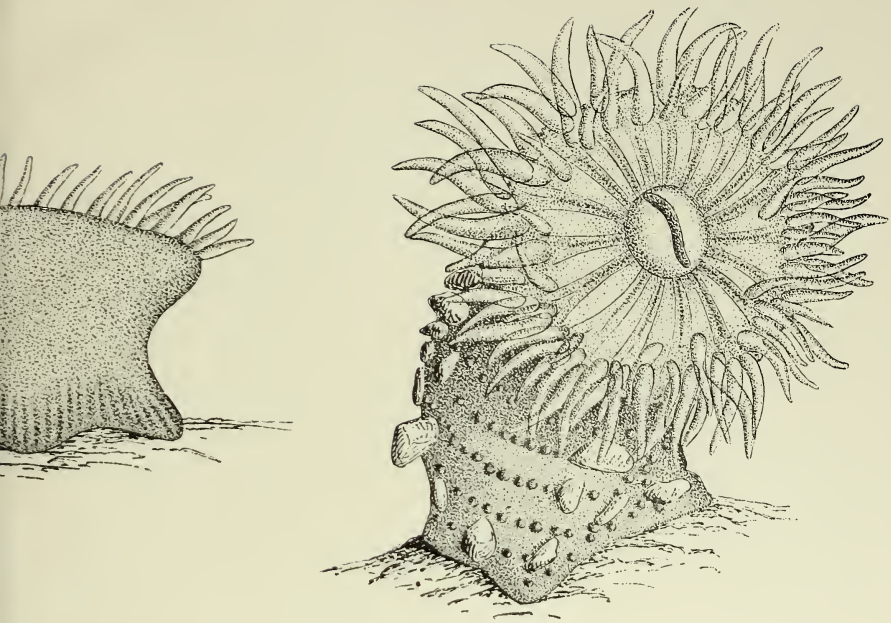
PLATE VI.



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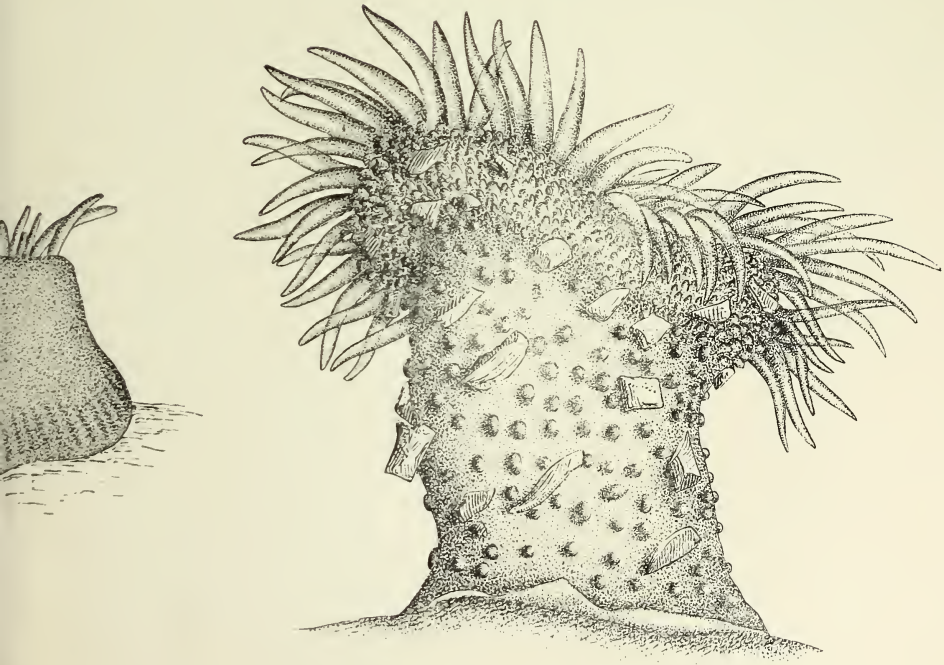

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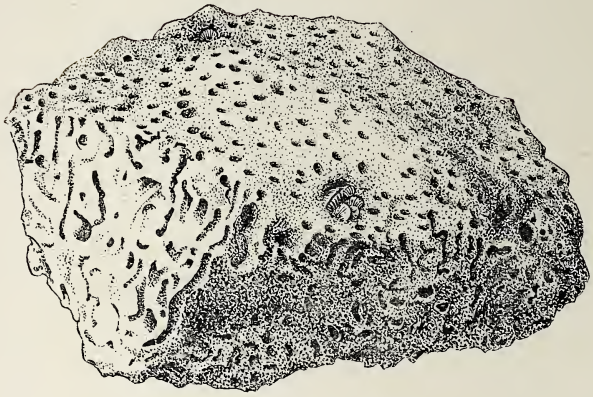

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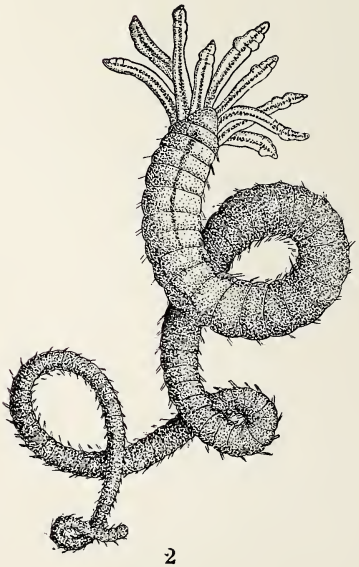

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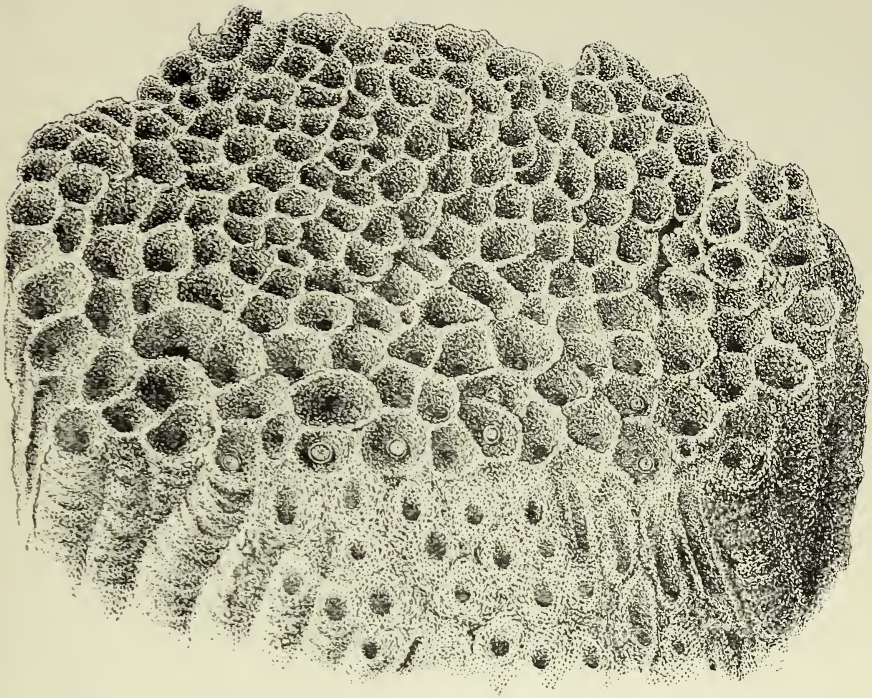

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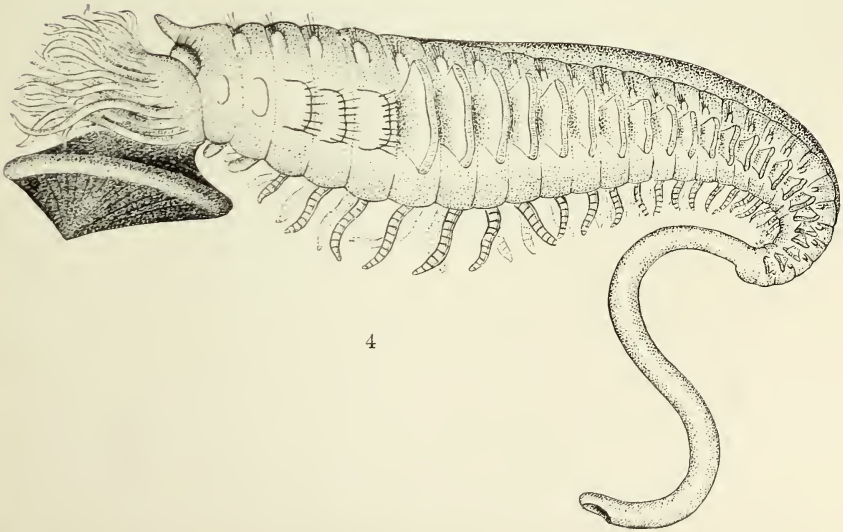

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BULLETIN

OF THE

ESSEX INSTITUTE.

Vol. 21. Salem: Oct., Nov., Dec., 1889. Nos. 10–11–12.

Annual Meeting, May 20, 1889.

The annual meeting was held this evening at 7.30 o'clock, the President in the chair. Records of the last annual meeting read and approved.

The reports of the Secretary, Librarian, Curators and Committees were read and accepted.

The reading of the report of the Treasurer was postponed to an adjournment of this meeting, on account of the absence of the Treasurer, Mr. Phippen, being on a journey for his health.

On motion of Mr. Whipple

Voted that when this meeting adjourns, it will be at the call of the Secretary.

The President called attention to photographs of two old oil paintings recently presented to the Institute by Mr. Waldo Higginson of Boston, whose letter explanatory of the same was read.

The first represents a scene in Madras about 1694, with portraits of Governor Nathaniel Higginson and wife, and Stephen Aynsworth who afterwards married Sarah Higginson, their daughter, born Dec. 2, 1697.

The second represents a scene in England about 1720, with portraits of Stephen Aynsworth and wife and her sister Deborah Higginson, born 1700.

Nathaniel Higginson was son of Rev. John Higginson of the First church in Salem, 1660–1708. He was born at Guilford, Conn., Oct. 11, 1652, a graduate of Harvard in 1670; went to England in 1674, and in 1683 was in the company's service at Fort St. George in the East Indies, was a member and secretary of the council and afterwards governor of the factory at the fort. He married Elizabeth, daughter of John Richards in May, 1692, returned to England in 1700 and established himself as a merchant in London, where he died in 1708.[1]

[At the adjourned meeting held on Monday, June 17, 1889, the Report of the Treasurer was read and accepted.]

The committee on nominations reported the following list of officers which was duly elected.

PRESIDENT.

HENRY WHEATLAND.

VICE-PRESIDENTS.

ABNER C. GOODELL, JR.,
FREDERICK W. PUTNAM,
DANIEL B. HAGAR,
ROBERT S. RANTOUL.

SECRETARY.

HENRY M. BROOKS.

TREASURER.

GEORGE D. PHIPPEN.

AUDITOR.

RICHARD C. MANNING.

LIBRARIAN.

CHARLES S. OSGOOD.

COUNCIL.

WILLIAM H. GOVE,
THOMAS F. HUNT,
DAVID M. LITTLE,
WILLIAM MACK,
EDWARD S. MORSE,
S. ENDICOTT PEABODY,
DAVID PINGREE,
EDMUND B. WILLSON,
GEORGE M. WHIPPLE,
ALDEN P. WHITE.

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[1] See Hist. Coll. Essex Institute, vol. v, page 35; Higginson's letters in Mass. Hist. Soc. Coll., vol. vii, 3d series, page 196; N. E. Hist. Gen. Reg., vol. 1, page 34.

THE RETROSPECT OF THE YEAR.

compiled from the several reports read at the meeting and remarks of the members in relation thereto, presents the work of the Institute in the various departments since the last annual meeting.

MEETINGS. Regular meetings occur on the first and third Monday evenings of each month; adjourned and special meetings have been occasionally held. At these the following communications were received and lectures delivered.

William P. Andrews, "A talk with Goethe about Faust."

S. M. Allis of Malden, "Arizona and its Mines."

Sylvester Baxter of Boston, "Berlin: a Study of Municipal Government in Germany."[1]

Henry P. Bowditch of Boston, "Composite Photography."

Benjamin W. Crowninshield of Boston, "An Account of the yacht 'Cleopatra's Barge of Salem.'"[2]

Edward Bangs Drew of Chelsea, "Chinese Customs and Home Life."

William Ralph Emerson of Concord, and *Ross Turner* of Salem, "Art and Architecture as applied to New England Houses."

G. T. Flanders of New Bedford, "On the Moorish Dominion in Spain."

Samuel Garman of Cambridge, "On the age of the Andean Medal;" "The Batrachia of Kalm's 'En Resa til Norra America;'" "Reptiles and Batrachians from the Caymans and from the Bahamas;" "On an Eel from the Marshall Islands."[3]

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[1] See Bulletin, Vol. XXI, p. 53. [2] See Hist. Coll., Vol. XXV, p. 81.
[3] See Bulletin, Vol. XX, pp. 57, 90, 101, 114.

Ezra D. Hines of Danvers, "On Folly Hill."

Cecil Hampden Cutts Howard of Brooklyn, N. Y., "Materials for a Genealogy of the Sparhawk Family in New England."[1]

Charles R. Keyes of Burlington, Iowa, "An Annotated Catalogue of the Mollusca of Iowa."[2]

J. S. Kingsley of Lincoln, Nebraska, "The Development of Crangon vulgaris." Third paper.[3]

John T. Moulton of Lynn, "Inscriptions from the old Burying Ground at Saugus Centre."[4]

Robert S. Rantoul, "Governor Endecott Estate;"[5] edited "The part taken by Essex County in the organization and settlement of the Northwest Territory;"[6] "Two Naval Songs."[7]

John H. Sears, "Geological and Mineralogical Notes: No 1, Sodalite."[8]

Eben F. Stone of Newburyport, on "Characteristics of Rufus Choate, Caleb Cushing and Robert Rantoul, jr."[9] A portion of the address had been delivered before the Essex Bar at the opening of the New Court rooms.

Frederick C. Test of Bloomington, Ind., "New Phosphorescent Organs in Porichthys."[10]

Alden P. White of Danvers, "On the Evolution of a County."

LIBRARY:—The additions to the Library for the year (May, 1888, to May, 1889) have been as follows:

By Donation.

Folios,	56
Quartos,	146
Octavos,	1,671
Twelvemos,	379

[1] See Hist. Coll., Vol. XXV, pp. 30, 119.
[2] See Bulletin, Vol. XX, p. 61.
[3] See Bulletin, Vol. XXI, p. 1.
[4] See Hist. Coll., Vol. XXV, p. 60.
[5] See Hist. Coll., Vol. XXV, p. 137.
[6] See Hist. Coll., Vol. XXV, p. 165.
[7] See Bulletin, Vol. XX, p. 84.
[8] See Bulletin, Vol. XXI, p. 88.
[9] See Hist. Coll., Vol. XXVI, p. 1.
[10] See Bulletin, Vol. XXI, p. 43.

Sixteenmos,	142
Twenty-fourmos,	53
Total of bound volumes,	2,447
Pamphlets and serials,	9,116
Total of donations,	11,563

By Exchange.

Folios,	4
Quartos,	6
Octavos,	95
Twelvemos,	22
Twenty-fourmos,	1
Total of bound volumes,	128
Pamphlets and serials,	2,418
Total of exchanges,	2,546

By Purchase.

Quartos,	5
Octavos,	57
Duodecimos,	1
Total of bound volumes,	63
Pamphlets and serials,	627
Total of purchases,	690
Total of donations,	11,563
Total of exchanges,	2,546
Total of purchases,	690
Total of additions,	14,799

Of the total number of pamphlets and serials, 3,608 were pamphlets and 8,553 were serials.

The donations to the Library for the year have been received from one hundred and eighty individuals and sixty-six societies and governmental departments. The exchanges from seven individuals and one hundred and seventy-six societies and incorporated institutions, of which eighty-six are foreign; also from editors and publishers. Among the donations to the Library during the past year, were three hundred and fifty-three bound volumes and two hundred and twelve pamphlets the bequest of the late Dr. J. A. Emmerton; five hundred and forty-eight volumes, mostly U. S. public documents from Hon. Geo. B. Loring and a large collection of horticultural and other newspapers from Charles H. Hovey of Cambridge.

We are pleased to be able to state that an increased interest has been manifested during the past year in the Library. The valuable and oftentimes rare works of reference which it contains have been oftener consulted, owing in a large measure, no doubt, to the better opportunity for so doing, which our increased facilities offer.

The Institute regards with unalloyed satisfaction the opening of a Free Public Library in Salem. The two institutions should supplement each other and thus each will be better able to serve the public, because of the existence of the other. The Institute will be able to pursue its special line of work without being called upon to cater to the popular demand for current literature; and the Public Library will not be obliged to spend large sums to duplicate works of reference in certain lines, which are always accessible at the Institute. A complete card catalogue has been made of the Art Library both by title and author, and a beginning has been made in preparing such a catalogue for the China Library. It is hoped that a complete catalogue of each room may in this way be made as the basis of a general and complete catalogue of the whole library.

Four assistants are now employed in the work of the Library. It is to be regretted that the efficient and capable assistant librarian, Miss Roberts, has been able, owing to ill health, to give but a small portion of her time to the Library, and this has somewhat delayed our progress in the matter of forwarding the cataloguing. We hope, during the coming year to exhibit more satisfactory results, in this respect.

The department of sociology still remains in Plummer Hall, as does also the larger part of the collection of pamphlets and most of the newspapers, except those of Essex County. This department has been largely increased during the past year.

Another year's experience has shown how great a benefit the Institute has derived from its removal to new quarters. Not only is the institution placed on a stronger and more stable basis by possessing a location of its own, but the large, pleasant and airy rooms attract to the library, visitors and students to whom the former contracted and limited space offered but little opportunity for study or research.

CHAS. S. OSGOOD, *Librarian.*

Donations or exchanges have been received from the following sources :—

	Vols.	Pam.
Abbot, Henry L., U. S. Army,		1
Adelaide, Royal Society of South Australia,	1	
Albany (N. Y.) Medical College,		1
Albany, New York State Library,	4	8
Albany, New York State Museum of Natural History,	1	1
Almy, James F.,		31
Alnwick, Eng., Berwickshire Naturalists' Field Club,		1
Altenburg, Naturforschende Gesellschaft des Osterlandes,		1
American Ornithologists' Union,		2
Ames, George L.,		1
Amherst College,		3
Amherst, Massachusetts Agricultural College,		8
Amherst, Massachusetts State Agricultural Experiment Station,		17
Amiens, Société Linnéenne du Nord de la France,		14
Amsterdam, Société Royale de Zoölogie "Natura Artis Magistra,"	1	
Andover, Phillips Academy,		1
Andover, Theological Seminary Library,		1
Andrews, Charles H.,	1	1
Andrews, John P.,		2
Andrews, Mrs. Ruth S.,	3	1
Andrews, Samuel P.,	121	216
Andrews, William P.,		13
Archer, A. J., Newspapers,	13	56
Ayer, J. C. & Co., Lowell,	1	
Bailey, Miss Mary O., Dorchester,	1	
Balch, G. B., Yonkers, N. Y.,		1

Baldwin, C. C., Cleveland, O.,	1	
Baldwin, William H., Boston,	1	
Baltimore, Md., College of Physicians and Surgeons,		1
Baltimore, Maryland Historical Society,	1	2
Baltimore, Md., Johns Hopkins University,	1	8
Baltimore, Md., Peabody Institute,		1
Batavia, Natuurkundige Vereeniging in Nederlandsch-Indië,	1	
Belfast Naturalists' Field Club,		1
Bergens Museum,		1
Berkeley, University of California,		10
Berlin, Naturforschende Gesellschaft,		1
Berlin, Verein zur Beförderung des Gartenbaues,		24
Bern, Naturforschende Gesellschaft,		1
Blinn, H. C., Shaker Village, N. H.,		12
Bolles, Rev. E. C., D.D., New York, N. Y.,	2	2
Bonn, Naturhistorischer Verein,	1	1
Bordeaux, Académie Nationale des Sciences, Belles-Lettres et Arts,	1	
Bordeaux, Société Linnéenne,		1
Boston, American Academy of Arts and Sciences,		3
Boston, Appalachian Mountain Club,		2
Boston Board of Health,		12
Boston, City of,	4	
Boston City Hospital,	1	
Boston, American Congregational Association,		1
Boston, Massachusetts General Hospital,		1
Boston, Massachusetts Historical Society,	4	
Boston, Massachusetts Horticultural Society,		1
Boston, Massachusetts Humane Society,		1
Boston, Massachusetts Medical Society,		1
Boston, National Association of Wool Manufacturers,		4
Boston, New England Conservatory of Music,		1
Boston, New England Historic-Genealogical Society,		5
Boston Public Library,		2
Boston, Sexton of the New Old South Church,		1
Boston Society of Natural History,		15
Briggs, Miss M. E.,	11	
Bristol (Eng.) Naturalists' Society,		2
Brooklyn (N. Y.) Library,		4
Brooks, Henry M.,	11	31
Brooks, Miss Margarette W.,		15
Brown, John T., Norwich, Ct.,	1	1
Brünn, Naturforscher Verein,	1	1

Brunswick, Me., Bowdoin College, ...		3
Bruxelles, Société Belge de Microscopie, . . .		5
Bruxelles, Société Entomologique, ...	1	
Bruxelles, Société Royale Malacologique, . . .	1	12
Buenos Aires, Sociedad Cientifica Argentina, . .		9
Buffalo (N. Y.) Library, ...		1
Butler, James D., Madison, Wis., ...	1	
Calcutta, Geological Survey of India, ...		6
Callendar, Hugh L., Cambridge, Eng., ...	1	1
Cambridge, Harvard University, ...		3
Cambridge, Museum of Comparative Zoölogy, . .		8
Cambridge, Peabody Museum of American Archæology and Ethnology, ...		2
Canada Royal Society, ...	1	
Chamberlain, James A., ... Maps,	27	79
Champaign, Ill., State Laboratory of Natural History, .		2
Chapel Hill, N. C., Elisha Mitchell Scientific Society, .		2
Charleston, S. C., Elliott Society of Science and Art, .		1
Cherbourg, Société Nationale des Sciences Naturelles, .	1	
Chever, Edward E., San Francisco, Cal., ...	1	3
Chicago (Ill.) Board of Trade, ...	2	2
Chicago, Burlington and Quincy Railway Co., . .		1
Chicago (Ill.) Historical Society, ...		1
Chicago, Rock Island and Pacific Railway Co., . .		1
Christiania, Université Royale, ...		8
Christiania, Videnskabs Selskabet, ...	1	
Cincinnati, Ohio Historical and Philosophical Society,		1
Cincinnati, Ohio Mechanics' Institute, ...		1
Cincinnati (O.) Society of Natural History, . . .		3
Clarke, Mrs. N. A., ...	15	1030
Cogswell, William, ...	1	238
Cole, Mrs. N. D., ... Newspapers,		
Columbus, Ohio Meteorological Bureau, ...		9
Conant, W. P., Charleston, S. C., . . Newspapers,		
Concord, New Hampshire Historical Society, . .		2
Copenhague, Académie Royale, ...		2
Copenhague, Société Botanique, ...		2
Cordoba, Academia Nacional de Ciencias, . . .		3
Crowell, Rev. E. P., Amherst, ...		4
Curwen, George R., ... Newspapers,	6	12
Curwen, James B., ... Newspapers,	6	24
Cutter, A. E., Charlestown, ...		1
Cutter, E., New York, N. Y., ...		1
Darling, C. W., Utica, N. Y., ...		2

Darmstadt, Verein für Erdkunde, ...		1
Davenport (Ia.) Academy of Natural Sciences, . .		1
Detroit, Mich., Microscope Publishing Co., . . .		4
Detroit (Mich.) Public Library, ...		1
Dodge, ——	1	51
Dodge, Grenville M., New York, N. Y., ...		1
Doran, Joseph I., Philadelphia, Pa., ...		1
Dresden, Naturwissenschaftliche Gesellschaft "Isis," .		2
Dresden, Verein für Erdkunde, ...	1	
Dublin, Royal Irish Academy, ...		9
Dublin, Roya. Society, ...		6
Duncan, Estate of James H., Haverhill, Newspapers,		19
Dyer, George L., U. S. Navy, ...	1	
Edinburgh Royal Society, ...	4	1
Edwards, Mrs. Henry W., . . . Newspapers,		
Emden, Naturforschende Gesellschaft, ...	1	
Emerton, James, ... Newspapers,	18	
Emmerton, Heirs of the late Ephraim, ...	1	
Emmerton, Bequest of the late James A., ...	353	212
Endicott, Charles, ...		1
Endicott, Estate of the late William P., ...	21	63
Erlangen, Physikalisch-medicinische Societät, . .		2
Essex (Eng.) Field Club, ...		4
Ewing, Thomas, Marietta, O., ...		1
Exeter, N. H., Phillips Exeter Academy, ...		1
Falmouth, Eng., Royal Cornwall Polytechnic Society, .	1	
Firenze, Biblioteca Nazionale Centrale, ...		26
Fletcher, W. I., Amherst, ...		15
Flynn, M. H., ...	1	
Frankfurt-a-M., Senckenbergische Naturforschende Gesellschaft, ...	1	2
Freiburg, Naturforschende Gesellschaft, ...		2
Genève, Institut National Genèvois, ...	1	
Genève, Société de Physique et d'Histoire Naturelle, .		1
Gillis, James A., Winchendon, ... Newspapers,		1
Glasgow, Natural History Society, ...		1
Goodrich, Mrs. Almira T., Portsmouth, N. H., Newspapers,		
Göttingen, K. Gesellschaft der Wissenschaften, . .	1	
Gould, John H., Topsfield, ...		2
Grant, Miss Beatrice, ... Newspapers,		
Granville, O., Denison University, ...		2
Gray, Miss Susan, ... Newspapers,		
Green, Samuel A., Boston, ... Newspapers,	51	295

Güstrow, Verein der Freunde der Naturgeschichte,		1	
Hale, Rev. E. E., Boston,		1	61
Halifax, Nova Scotian Institute of Natural Science,			1
Hall, James, Albany, N. Y.,		4	15
Halle, K. Leopoldinisch-Carolinische D. Akademie,		1	5
Hamburg, Naturwissenschaftlicher Verein,		1	
Hannover, Naturhistorische Gesellschaft,			1
Harlem, Société Hollandaise des Sciences,			4
Harris, Miss R. A.,		9	
Hartford, Ct., Trinity College,			1
Hassam, John T., Boston,		2	1
Higginson, T. W., Cambridge,		1	
Hildeburn, Charles R., Philadelphia, Pa.,			1
Hill, H. A., Boston,		1	
Hitchcock, Edward, Amherst,			1
Hoadly, C. J., Hartford, Conn.,			1
Hoar, George F., Worcester,			1
Hobart, Government of Tasmania,		1	
Hobart, Tasmania Royal Society,		1	
Hotchkiss, Justus S., New Haven, Conn.,			1
Hovey, Charles H., Cambridge,	Newspapers,		188
Hunt, Thomas F.,	Newspapers,	52	145
Hyatt, Alpheus, Boston,			2
Iowa City, Iowa State Historical Society,			4
Israel, Mrs. Fielder,	Newspapers,	3	415
Israel, Rev. Fielder,	Newspapers,		55
Ives, Henry P.,	Newspapers,	2	
Jenkins, Steuben, Wyoming, Pa.,			5
Jenks, Rev. Henry F., Canton,		1	
Keyes, Charles R., Burlington, Ia.,			3
Kilby, W. H., Boston,		1	
Kimball, James P., Washington, D. C.,		11	31
Kingsley, J. S., Bloomington, Ind.,		1	32
Kjöbenhavn, Botaniske Förening,			1
Kjöbenhavn, K. D. Videnskabernes Selskabs,			1
Knight, Miss M. E.,		21	
Königsberg, Physikalisch-ökonomische Gesellschaft,		1	
Lamson, Frederick,		6	15
Lansing, Michigan State Library,		13	8
Lausanne, Société Vaudoise des Sciences Naturelles,			1
Lawrence, George N., New York, N. Y.,			6
Lawrence Public Library,			1
Lee, Francis H.,	Newspapers,		69
Leeds, Eng., Literary and Philosophical Society,			1

Le Mans, Société d'Agriculture, Sciences et Arts de la Sarthe,		1
Liège, Société Royale des Sciences,	1	
Lincoln, Nebraska University,		1
Little, David M.,	7	15
Littleton Lyceum,		1
Livingston, Mrs. William G., Peterborough, N. H., Newspapers,		
London, Royal Society,		25
Longenecker, J. H., Harrisburg, Pa.,	5	
Loring, George B.,	548	2
Lowell, Old Residents' Historical Association,		1
Lund, Université Royale,		2
Luscomb, Charles B., Brooklyn, N. Y.,		14
McClure, P. F., Bismarck, Dak.,	1	
McDaniel, Rev. B. F., San Diego, Cal., Newspapers,		1
Macfie, R. A., Neston Chester, Eng.,	1	
Mack, William,	6	201
McKee, James Cooper, Watertown,		1
Madison, Wis., State Historical Society,	3	1
Madrid, Observatorio,	3	
Madrid, Sociedad Española de Historia Natural,		3
Manchester, Eng., Literary and Philosophical Society,	2	2
Manning, James,	1	
Marsh, Lucius B., Boston,	2	
Marshall, John W., Rockport,		1
Marston, Estate of the late Miss Isabella T.,	184	
Massachusetts Commonwealth, Secretary of,	10	3
Massachusetts Society for promoting Good Citizenship,		1
Massachusetts State Board of Health,	2	53
Meek, H. M.,	2	9
Meriden (Ct.) Scientific Society,		1
Merrill, William, jr., West Newbury.	13	1
Michigan Agricultural College,		19
Middletown, Ct., Wesleyan University,		1
Milwaukee, Wisconsin Natural History Society,		5
Montreal (Can.) Natural History Society,		4
Morse, Edward S.,	3	62
Moseley, Edward A., Washington, D. C.,	1	
München, K. b. Akademie der Wissenschaften,		14
Napoli, R. Accademia delle Scienze fisiche e matematiche,	2	10
Nelson, William H.,	1	
Neuchâtel, Société des Sciences Naturelles,	1	
Nevins, W. S.,		2

Newark, New Jersey Historical Society, ...	4	17
New Bedford, First Congregational Society, . .	1	
Newell, Miss M. E., Brookline, . . Newspapers,		
New Haven (Conn.,) Colony Historical Society, . .		2
New Haven, Connecticut Academy of Arts and Sciences,		1
New Haven, Conn., Yale University, ...	1	4
Newport, R. I., Redwood Library, ...		1
New York, N. Y., Academy of Anthropology, . .		1
New York, N. Y., Academy of Sciences, ...		9
New York, N. Y., American Geographical Society, .		5
New York, N. Y., Astor Library, ...		1
New York, N. Y., Central Park Menagerie, . . .		1
New York (N. Y.) Chamber of Commerce, . . .	1	
New York (N. Y.) Genealogical and Biographical Society, ...		4
New York (N. Y.) Historical Society, ...	1	3
New York, N. Y., Linnæan Society, ...		1
New York (N. Y.) Mercantile Library Association, .		3
New York (N. Y.) Microscopical Society, . . .		4
New York (N. Y.) Post Graduate Medical School and Hospital, ...		1
New York, N. Y., Torrey Botanical Club, . . .		1
Nichols, Andrew, jr., Danvers, ...	1	2
Nichols, John H., ... Newspapers,		53
Northend, William D., ...	82	1
Nourse, Miss Dorcas C., ... Newspapers,		
Nourse, Thorndike, London, Eng., ...	1	
Nurnberg, Naturhistorische Gesellshaft, ...		2
Ottawa, Canada Geological and Natural History Survey, Maps,	4	3
Palermo, R. Accademia di Scienze, Lettere e Belle Arti,		7
Palfray, Charles W., ... Newspapers,	1	233
Paris, Société d'Acclimatation, ...		24
Paris, Société d' Anthropologie, ...		4
Paris, Société des Etudes Historiques, ...	1	
Payson, Edward H., ...	17	82
Peabody, George L., Philadelphia, Pa., ...	2	
Peabody Institute, Peabody, ...	1	1
Peet, Rev. S. D., Mendon, Ill., ...		6
Peirce, Estate of the late Nathan, ...	5	
Perkins, George A., ...		17
Perkins, Henry A., Philadelphia, Pa., ...		1
Perley, M. V. B., Ipswich, ...	1	
Perley, Sidney, ...		2

Perry, Rev. William S., Davenport, Ia.,		1
Pettee, Benjamin, Boston,	18	
Philadelphia, Pa., Academy of Natural Science,		3
Philadelphia, Pa., American Philosophical Society,		5
Philadelphia, Pa., Indian Rights Association,		23
Philadelphia, Pa., Library Company,		3
Philadelphia, Pennsylvania Academy of Fine Arts,		2
Philadelphia, Pennsylvania Historical Society,		2
Philadelphia, University of Pennsylvania,	1	
Philbrick, Misses H. and E., Newspapers,		30
Phillips, Henry, jr., Philadelphia, Pa.,		1
Phillips, Stephen H.,		1
Phippen, Joshua, Newspapers,		
Pickering, Miss Sallie,	14	52
Plumer, Miss Mary N., Newspapers,		3
Pool, Wellington, Wenham,		2
Porter, Rev. Aaron, Newspapers,		102
Powell, Charles T., Boston,		1
Providence, Rhode Island Historical Society,		1
Providence, R. I., Narragansett Historical Publishing Company,		5
Providence (R. I.) Public Library,		1
Pulsifer, David, Boston,	1	
Putnam, Rev. A. P., Concord,		1
Putnam, F. W., Cambridge,		2
Quebec, Can., Literary and Historical Society,		1
Quinn, Thomas,		1
Rantoul, Robert S.,	1	23
Redmond, C. C.,		1
Regensburg, K. Bayerische Botanische Gesellschaft,	1	
Regensburg, Naturwissenschaftlicher Verein,		1
Rice, Franklin P., Worcester,		1
Rice, William, Springfield,		1
Richmond, Virginia Historical Society,	1	
Rio de Janeiro, Museo Nacional,	1	
Roberts, Mrs. J. K., Newspapers,		4
Roberts, Miss M. L.,		11
Robinson, John, Newspapers,	1	13
Roma, Biblioteca Nazionale Centrale Vittorio Emanuele,		8
Ropes, Willis H., Newspaper,		
Russell, John A., San Francisco, Cal.,	1	
Sacramento, California State Library,	116	
St. John, New Brunswick Natural History Society,		1
St. Louis, Mo., Academy of Sciences,		1

St. Louis (Mo.) Public Library,		2
St. Paul, Minnesota Historical Society,		1
St. Pétersbourg, Académie Impériale des Sciences,		9
St. Petersburg, Societas Entomologica Rossica,	2	
Salem, First Church,		40
Salem, First National Bank,	6	
Salem Fraternity,	114	2404
Salem National Bank,	29	11
Salem, Peabody Academy of Science,	3	209
Salem Press,		240
San Francisco, Cal., Board of Supervisors,	11	
San Francisco (Cal.) Free Public Library,		1
San Francisco (Cal.) Mercantile Library Association,		1
San Francisco, Cal., Society of the Sons of Revolutionary Sires,		1
Sargent, Stephen Hoyt,	1	
Savannah, Georgia Historical Society,		1
Scranton, Pa., Lackawanna Institute of History and Science,	1	
Shanghai, China Branch of the Royal Asiatic Society,		4
Sheffield, W. P., Newport, R. I.,	1	1
Sheldon, George, Deerfield,		1
Short, Miss J. H., . Circular,		
Simon, Miss Adaline F.,	29	23
Sims, Mrs. R. T., . Newspapers,		
Skinner, J. P.,		5
Smith, A. Aug.,		265
South Boston, Perkins Institution and Massachusetts School for the Blind,		1
Stettin, Entomologischer Verein,	1	
Stewart, William M., Washington, D. C.,		1
Stickney, George A. D.,	5	
Stimpson, T. M., . Newspapers,		
Stockholm, Société Entomologique,		4
Stone, Mrs. Ellen A., East Lexington, Newspapers,		2
Stone, F. D., Philadelphia, Pa.,	1	
Stone, George F., Chicago, Ill.,	1	
Stone, Henry, Boston,		1
Stone, Miss Mary H.,		30
Stone, Robert, . Newspapers,		
Sydney, Linnean Society of New South Wales,		1
Sydney, Royal Society of New South Wales,	1	1
Taunton, Eng., Somersetshire Archæological and Natural History Society,	1	
Tennessee State Board of Health,		12
Thayer, Oliver,	17	

Throndhjem, K. N. Videnskabers Selskab,		1
Titus, Rev. Anson, Towanda, Pa.,		1
Topeka, Kansas Historical Society,	18	12
Topeka, Kan., Washburn College Laboratory of Natural History,		1
Toronto, Can., Canadian Institute,		1
Townsend, John P., New York, N. Y.,		1
Trenchard, Edward, New York, N. Y.,		2
Trenton (N. J.) Natural History Society,		1
Trenton, New Jersey State Library,	1	
Tromso Museum,		20
Trumbull, Walter H., Newspapers,		
Turner, J. H., Idel, Bradford, Eng.,		4
Turner, Ross,	4	56
Underwood, Miss Jennie, Danvers,	74	9
Unknown,	1	3
Upton, Winslow, Providence, R. I.,		1
U. S. Bureau of Education,	1	5
U. S. Chief of Engineers,	4	
U. S. Chief of Ordnance,	2	
U. S. Chief Signal Officer,	2	1
U. S. Coast and Geodetic Survey,	1	8
U. S. Comptroller of the Currency,	2	
U. S. Department of Agriculture,		4
U. S. Department of the Interior,	97	
U. S. Department of State, Maps,	36	13
U. S. Fish Commission,	9	
U. S. Geological Survey,	3	9
U. S. Life Saving Service,	1	
U. S. National Museum,		8
U. S. Patent Office,		58
U. S. Quartermaster General,	1	
U. S. Surgeon General,	1	
U. S. Treasury Department,	1	
U. S. War Department,	5	1
Walton, Mrs. Eliza A., Ipswich,	1	
Washington, D. C., Anthropological Society,		3
Washington, D. C., Smithsonian Institution,	2	5
Watanabe, Hiromoto, Tokio, Japan,		1
Waters, E. S., Minneapolis, Minn.,		1
Waters, J. Linton, Newspapers,		7
Waterville, Me., Colby University,		1
Watson, Miss C. A., North Andover, Newspapers,		19
Watson, S. M., Portland, Me.,		1
Weeks, Stephen B., Chapel Hill, N. C.,		2

Welch, W. L.,	135	105
Wheatland, Henry,		8
Whipple, George M., Newspapers,	7	192
Whipple, Prescott, Newspapers,		52
Whitney, Mrs. H. M., Lawrence, Newspapers,		5
Wien, K. K. Zoologisch-Botanische Gesellschaft,		4
Wien, Verein zur Verbreitung Naturwissenschaftlicher Kenntnisse,	1	
Wiesbaden, Verein für Naturkunde,		1
Wilder, E. W., Boston,		3
Willson, Mrs. E. B., Newspapers,		
Willson, Rev. E. B., Newspapers,		492
Winsor, Justin, Cambridge,		32
Winthrop, Robert C., Boston,		12
Women's Anthropological Society of America,		1
Woods, Mrs. Kate T., Newspapers,		
Worcester, American Antiquarian Society,		2
Worcester, Society of Antiquity,		1
Wright, Frank V.,	1	111
Wright, W. H. K., Plymouth, Eng.,		9
Würzburg, Physikalisch-Medicinische Gesellschaft,	1	

The following have been received from editors or publishers:

American Exchange and Mart.
American Journal of Science.
American Naturalist.
Beverly Citizen.
Cape Ann Advertiser.
Chicago Journal of Commerce.
Danvers Mirror.
Georgetown Advocate.
Groton Landmark.
Iowa Churchman.
Ipswich Chronicle.
La Bibliophile.
Lawrence American.
Le Naturaliste Canadien.
Lynn Bee.
Manifesto.
Martha's Vineyard Herald.
Musical Herald.
Musical Record.
Nation.
Naturalists' Leisure Hour and Monthly Bulletin.
Nature.
New England Magazine.
Open Court.
Our Dumb Animals.
Peabody Press.
Peabody Reporter.
Sailors' Magazine and Seamen's Friend.
Salem Gazette.
Salem News.
Salem Observer.
Salem Register.
Salem Sun.
Statesman.
Traveler's Record.
Voice.
Zoologischer Anzeiger.

THE MUSEUM. The donations to the Museum during the year number 369 from 102 contributors. The specimens in natural history, including those in archæology, which have been received during the year, have been placed on deposit with the Trustees of the Peabody Academy of Science, in accordance with previous arrangements; those of an historical character, or which possess an artistic interest, have been placed in the rooms of the Institute. They have been received from the following donors:

James A. Chamberlain; Andrews, Moulton & Johnson; Edw. A. Smith; H. M. Brooks, mourning rings, etc.; Wellington Pool of Wenham; Prescott Whipple; Mrs. R. S. Andrews, a miniature of Rev. S. P. Hill; A. Averill; John P. Andrews, picture of Bark Patriot of Salem 1817; George R. Curwen, miniature, Para rubber shoes; Francis H. Wade, collection of log books; Edward S. Morse; Chas. H. Andrews; Wm. M. Hill; Mrs. Chas. Osgood; Mrs. H. M. Brooks, scrap-box made by the Misses Derby of South Salem with collection of plaster casts; Mrs. Maria H. Bray of East Gloucester; J. Archer Hill; Miss Sarah E. Smith, fan made in Paris, 1796, with American and French emblems; Arthur H. Tibbets, oil painting by B. F. West of Salem, whaling scene about 1837; Perry Collier; Dan'l Henderson; Thomas H. Johnson; Edwin O. Foster; C. W. Browne; Edw. B. Lane; E. H. Payson, steelyards 150 years old and pocket-book of Col. Abner Cheever of the Boston Tea Party; John P. Tilton; Francis H Lee; John Robinson, lith. death bed of Harrison 1841, Franklin stove, mourning ring 1740, autograph letter of W. E. Gladstone; Geo. H. Allen, photograph of ship Panay, framed; W. L. Welch; Henry M. Batchelder; Chas. B. Luscomb of Brooklyn, N. Y.; Samuel Thorner; Geo. L. Ames, Washington plate; Mrs. D. A. Russell of Waverly; Mrs. Eliza G. Waters; John B. Skinner; Josiah M. Crocker; James Chamberlain; Misses M. E. and H O. Williams; Mrs. Anna J. Haskell of W. Roxbury, wax dolls from Paris in 1838; Samuel P. Andrews; Merchants National Bank; Geo. M. White; Margaret M. Haskell; E. M. R. Brooks; Mary S. Cleveland; Mary Otis Bailey of Dorchester, old papers, deeds, etc.; Lucy H. Cleveland; Annie E. Snell; Fielder Israel; M. H. Flynn; Charlotte Crowninshield; Ross Turner; Thos. F. Hunt; Frank V. Wright; Mrs. Jos. Winn of Newton; Capt. Wm. H. Nelson, painting of the destruction of the ship Harvey Birch by Confederate cruiser Nashville, Nov. 19, 1861; Miss Susan V. Hotchkiss of New Haven; the Misses King of Beverly, framed portrait of Hon. John G. King, 1825; Caleb Buffum; Rev. Chas. Noyes of North Andover; John Cross of Liverpool, Florida; Misses Chadwick, loom

for fringe, tape, etc.; David Moore, Exer. Est. Miss I. T. Marston; Henry P. Ives; Mrs. Paul B. Lakeman of Ipswich, ancient lace frame; Andrew K. Ober of Beverly, ancient horn spoon; Henry Wheatland; T. M. Proctor of Essex; W. P. Upham of Newtonville; Estate of Jas. A. Emmerton, picture of ship Francis of Salem, 24 log books, statuette of Venus in plaster; Henry W. Putnam; Mrs. F. H. Lee, Chinese paintings on rice paper; Kate T. Woods; Benjamin Barstow; Mrs. N. O. Very; Jas. C. Casey; James Coffey; H. K. Oliver, M. D. of Boston, manuscript address of Gen. Oliver at the 50th anniversary of the Salem Lyceum; James Manning; Essex County Teachers' Association; Estate of J. H. Duncan of Haverhill; Miss Mary H. Stone; Henry A. Chase; J. Linton Waters; Willis H. Ropes; Mrs C. K. Ireson, original stamp seal of the Salem mill dam; estate of Sarah O. Russell; N. A. Horton & Son; Dr. Geo. A. Perkins; Waldo Higginson of Boston, two framed photographs of Gov. Higginson and wife and Stephen Aynsworth and wife, from paintings about the close of the seventeenth century; Geo. Upton; Mrs. S. M. Trow of Ipswich; Miss Lucy P. Robinson, postage stamp album and postage stamps; H. H. Moore of San Francisco, Cal.

Fine Arts. The committee on Fine Arts would report the successful termination of a course of Chamber Concerts given at Academy Hall under the direction of this Committee. No attempt was made as in former years to get subscriptions from those who generally subscribe to Institute entertainments through friendship for the society alone. It was the wish of your Committee to discover, if possible, whether there was such a demand for concerts of the character proposed as would warrant the Institute in undertaking to provide them. Circulars were, therefore, sent to all persons in Salem and vicinity known to be interested in music, and a subscription paper was left at the store of Mr. E. V. Emilio. The subscription amounted to $297, this with a balance of $150, in the hands of the Committee which could be utilized for the purpose, and the generous offer of the Peabody Academy of Science, not only to share a portion of the expenses of the Hall, but also to remit all charges in case the concerts were not successful, encouraged your Committee to proceed.

The concerts cost		$432.53
The subscription was	$297.00	
And door sales	23.50	
Total receipts		$320.50
Showing a direct loss of		$112.03

which was made up from the balance above named. It is evident to your committee that with a little exertion, and with the hearty coöperation of several well-known musicians promised for next season, it would be wise for the Institute to arrange for a course of concerts next season similar to that just closed. This Committee would also suggest that it would be well to add to the number, two concerts in which the services of a small orchestra could be secured. The course to consist of five as follows:—

Two trio—violin, 'cello and piano,
One quartet,
Two with small orchestra.

These concerts could be given it is thought at not much, if any, greater expense, and would appeal to a larger circle of music lovers. Your committee would also suggest that the programs be carefully made up, and that the concerts do not exceed in length an hour and twenty minutes, thus allowing patrons to take early cars to Peabody, Beverly, etc.

The thanks of this Committee are due to the Trustees of the Peabody Academy of Science, and the attachés of Academy Hall for courtesies extended; and also to Messrs. Foote, Fenollosa and Phippen for their efforts in making the concerts an artistic success, as well as to the other artists taking part in the different concerts of the series, all of whom exhibited special and kindly interest in the undertaking.

For the Committee,

EDWARD S. MORSE,

March 6, 1889. *Chairman.*

TREASURER'S REPORT. Receipts and expenditures of the past year (condensed from account presented).

RECEIPTS.

For balance of last year's account,		$588 27
" legacy from the late Dr. J. A. Emmerton,	$10,000 00	
" interest of the manuscript fund,	59 56	
" " " " Derby Fund,	31 60	
Amount to be invested,		$10,091 16
" assessments of members,	$903 00	
" income of invested funds,	2,674 37	
" sale of publications,	425 05	
" amount from other sources,	175 91	
Net income,		$4,178 33
		$14,857 76

EXPENDITURES.

By investment of legacy from Dr. J. A. Emmerton,	$10,395 94	
" amount added to deposit of manuscript fund,	59 56	
" " " " " " Derby fund,	31 60	
Amount invested,		$10,487 10
" salaries of secretary, assistant-librarians and janitor,	$1,765 00	
" cost of publications and printing,	1,052 94	
" cost of books,	133 81	
" cost of fuel,	225 75	
" paid Salem Athenæum, portion of repairs and expenses,	279 28	
" cost of postage, expressage, stationery, etc.,	247 04	
" premiums of insurance,	38 50	
" city tax on barn,	22 40	
" annuities, accompanying legacies,	210 00	
Net expenses,		$3,974 72
Balance cash on hand,		395 94
		$14,857 76

June 14, 1889. Respectfully submitted,

GEO. D. PHIPPEN, *Treasurer.*

Examined and approved,

R. C. MANNING, *Auditor.*

INVESTMENT OF THE FUNDS.

For purposes of income, (cost),		$61,227 96
" occupancy, viz., "The Essex Institute Building," first cost,	14,000 00	
" repairs and improvements thereon,	14,370 69	
The Ship Rock and land as on books,	100 00	
		$28,470 69
Total investment,		$89,698 65

Salem, June 14, 1889. Examined and found to agree with the securities,

R. C. MANNING, *Auditor.*

Members. It is with a profound sense of the losses which have occurred to the Institute, since its last annual meeting, that we refer to the deaths of several of its members, some of whom have been widely known as holding or having held official relations, or as contributors of papers to the publications, of books to the library, of manuscripts of various kinds to its archives, specimens to the cabinets, portraits and other paintings to the art department. These have left blanks in our fellowship it seems impossible to fill.

Eleazer Austin died on Sunday, March 10, 1889, at his residence, 58 Lafayette street, Salem; son of Richard and Isabella (Symonds) Austin, and was born in Salem May 14, 1804. In early life he was a shoe manufacturer, having his factory on Hamilton street; subsequently, for fifty years, in the lumber business, having a wharf on the South river and his office near South bridge. He was the United States assessor of internal revenue for ten years. In 1877 he was elected an assessor of the city and served continuously in that office until 1886, when he retired on account of ill health. He was also an alderman in 1854 and 1855, and a member of the first board of trustees of the Plummer Farm School for boys. Mr. Austin was a worthy man in every relation of life, possessed of good judgment, and was highly esteemed.

Admitted to membership May 21, 1856.

George Francis Choate, of Salem, judge of probate and insolvency for the county of Essex, Mass., died at Sharon Springs, in New York, on the 11th of July, 1888. He was the son of William and Lucretia (Burnham) Choate, was born in the town of Essex, Feb. 9, 1822, and was descended from one of the oldest and most re-

spected families in the county; a graduate of Bowdoin college in 1843; after teaching, two years, a school in his native town, he entered the law office of Hon. Jonathan C. Perkins of Salem, and there pursued his studies. In 1847 was admitted to the Essex bar, and entered into law partnership with William D. Northend of Salem, under the firm name of Northend & Choate, which was continued until his appointment of Judge of Probate and Insolvency for the county of Essex, in 1858. This office he held until the time of his death.

Judge Choate possessed in an eminent degree the qualities of mind and the temperament essential in the performance of judicial duties; always dispassionate and self-possessed, he tried cases with great patience and impartiality and was very frequently called to act as arbitrator by parties as well as courts. He was a careful and industrious student, well grounded in the principles of common law, modest and unassuming in his manners. He took a deep interest in the cause of education, and served on the Board of School Committee of Salem fourteen years, and he was for many years previous to the time of his death a trustee of Dummer Academy.

Admitted to membership, Dec. 19, 1870.

George Robinson Emmerton died very suddenly on Tuesday morning, May 22, 1888, at his residence in Salem. He was the son of Ephraim and Mary Ann (Sage) Emmerton, one of Salem's distinguished merchants of the past generation. He was born in Salem, Feb. 9, 1836, and was educated at her schools; thence went to the busy counting room of Glidden & Williams, of Boston, and had his full share of the bustle of early California freighting times.

He was intensely patriotic; when the civil war broke

out, at the age of 25, he became a member of the Union Drill Club, of which he was a lieutenant. This organization went to the front, as Company "F," 23d Mass. Vol. Inf., in November, 1861 — G. M. Whipple, Capt., Charles H. Bates, 1st Lieut., George R. Emmerton, 2d Lieut. In this capacity he shared the fortunes of Burnside's North Carolina campaign, till mid-summer of 1862, when he was taken sick, and came home an invalid, whose hold on life was thought to be very uncertain. His recovery was so slow that he was unable to accept the promotion that awaited him, and, unwilling to occupy a position, the duties of which he was unable to perform, he reluctantly resigned.

After the war, he was associated for a time with his brother, Capt. E. Augustus Emmerton, in the manufacture of bleaching powders, in Boston. Subsequently, the partnership was dissolved and both entered the mercantile house of the late John Bertram, whose daughter Mr. Emmerton married. Upon the retirement of Captain Bertram, our last great merchant, he became the junior partner of the firm of Ropes, Emmerton & Co., which has since conducted the extensive business with Zanzibar, Madagascar and the Red Sea ports, founded by Captain Bertram, owning the barques Taria Toppan, Glide and Essex. Mr. Emmerton acquired wealth, and about a year ago completed extensive changes in the old mansion, owned and occupied for many years by the late William Pickman, making of it a most elegant house, in which he and his family resided at the time of his death; he showed his affection and interest for his fellow-citizens, even in this, that none but Salem mechanics were employed upon the building and none of the work done was by contract.

He served on the Board of Aldermen in 1877, '78, '79, '80, and was the first to hold the office of President of the

Board, after that position was created. His services were of such great value to the city, that he had been, on several occasions, besought to accept the nomination of the mayoralty, but steadily declined its acceptance.

He was president of the Merchants' National Bank, of Salem, vice president of the Salem Savings Bank, a trustee of the Salem Hospital, chairman of the standing committee of the First (Unitarian) Church, one of the original trustees of the Salem Public Library, elected by the city council, Feb. 26, 1888. His was the first death in that Board. He was largely instrumental in the consummation of the arrangements by which the Bertram estate was deeded to the city, for a public purpose, and manifested great interest in this embryo institution, and his loss was severely felt by his associates; he also expressed a like degree of interest in the proposed memorial to the patriotic dead of Salem, a few years since, making at the time a munificent offer to share in the expense, but the city council failed to adopt the idea, and the matter was dropped.

A member of the Finance Committee of the Essex Institute since 1879, he took an active part in the purchase of the Daland house and fitting the same for the arrangement of its library and various collections. Mr. Emmerton was a man of independence, of great firmness and decision of character, of marked integrity and uprightness as a citizen, and was greatly respected by those associated with him in trusts and business affairs generally.

Admitted to membership, July 1, 1878.

James Arthur Emmerton died on Monday evening, December 31, 1888, after a short illness at his home, in Salem. It is a noteworthy circumstance that this is the second somewhat sudden death that has occurred in the Board of Trus-

tees of the New Public Library; his own brother, George R. Emmerton, being the first. He was a son of the late Ephraim Emmerton and lived in the old family mansion, on Summer street. He was born August 28, 1834, pursued his preparatory studies at the Salem Latin School, under the principalship of Oliver Carlton; graduated at Harvard College in the class of 1855; the Harvard Medical School in 1858; spent six months abroad in 1858–9, a resident student at the Rotunda Lying-in Hospital, and attendant surgeon Wildes' Eye and Ear Cliniques at Dublin.

At the commencement of hostilities, he enlisted in company "F," 23d Reg. Vol. Infantry in October, 1861, and was warranted as corporal. His army record is as follows:

Corporal, Co. F, 23d Mass. Vols., October 1, 1861; left the state November 11, 1861; battle at Roanoke Island, N. C.; as volunteer served a howitzer gun landed from a transport, and the same at the battle of Newbern; detailed acting Asst. Surgeon, 23d Mass. Vols., April, 1862; Asst. Surgeon, 23d Mass. Vols., July 31, 1862; ordered to Roanoke Island, August 24, 1862; Post Surgeon, Plymouth, September 28; ordered to Foster U. S. Gen. Hospital, Newbern, January, 1863; rejoined his Regiment, at Newport News, Va., October 22; joined the rendezvous with his Regiment, April, 1864; in the field of action between the Appomattox and James Rivers, in May, and Cold Harbor in June; Surgeon, 2d Mass. H. A., May 26, 1864; joined his regiment at Newbern, N. C., June 27; went with five companies of his regiment to open communications with General Sherman, March 3, 1865; in charge of Post Hospital, May; mustered out, September 3, 1865.

After leaving the army where his gallantry was conspicuous he was assistant physician in the New York State Lunatic Asylum, at Utica, in 1866-7; retiring from this position he gave up the practice of medicine and devoted much of

his time to genealogical and historical studies. In 1879 with his college classmate and fellow soldier, and life-long intimate, Henry Fitzgilbert Waters, he was searching English records and collecting a large amount of valuable information that has been published by the Institute in its Historical Collections. He was the historian of the twenty-third regiment, and prepared one of the best regimental histories of the state, issued from the press.

He compiled a genealogy of the Emmerton family in 1881, privately printed at the Salem Press.

The following communications compiled by him have been printed in the Historical Collections of the Institute:

"Deacon Richard Prince of Salem, and some of his descendants," Vol. XIV, p. 249.

"Notes and Extracts from the Records of the First Church of Salem, 1629–1736," Vol. XV, p. 70, and Vol. XVI, p. 8.

"Gleanings from English Records about New England Families." The results of a summer residence in London, 1879, in company with his friend H. F. Waters, Vol. XVII, pp. 1–147.

"A genealogical account of Henry Silsbee and some of his descendants," Vol. XVII, p. 257.

"Dr. Bentley's East Parish deaths, some notes and corrections," Vol. XX, p. 209.

"Eighteenth-century Baptisms in Salem, Mass., hitherto unpublished," Vols. XXII, XXIII.

These communications are a valuable contribution to our local history and will be of inestimable value to the future historian and a noble tribute to his memory as a faithful and zealous worker in this field of labor. In addition to his life's work, of which we have many illustrations, he has left a fund, the income, after the lapse of a contingency, to be appropriated for the printing of the old records and other

historical materials; though dead, yet he will be in the future contributing material aid in the promotion of historical studies and research.

Dr. Emmerton's interest in libraries and library systems, his familiarity with books, having had a large and valuable library of his own, his taste for literature and the fine arts, his interest in local history, also the leisure to attend to the duties, rendered him a very suitable person to occupy a place on the board of trustees of the new public library, to which he was called by a vote of the city council on the evening of February 27, 1888 (the board of trustees consists of six persons originally elected by the city council, with the mayors of the city, ex-officio, chairmen; vacancies by death or resignation to be filled by the remaining members). We cannot conclude this notice of Dr. Emmerton without alluding to the assiduous care and attention that he bestowed upon his aged father during the declining years of his life, and even to its close which occurred on March 22, 1877.[1]

Admitted to membership, January 14, 1856.

William H. Foster, the oldest bank officer in the United States, and cashier emeritus of the Asiatic National Bank of Salem, died at his home in that city, on Friday

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[1]Captain Ephraim Emmerton was a son of Jeremiah and Elizabeth (Newhall) Emmerton, born in Salem, July 6, 1791, married June 8, 1826, Mary Ann, daughter of Daniel and Deborah (Silsbee) Sage, [b. April 1, 1815, d. March 22, 1879.] Commercial pursuits were his life's business; in the early part following the seas, captain or supercargo, or both, of vessels engaged principally in the East India trade and after his marriage, employing his capital in the familiar Calcutta channels, and afterwards in the Zanzibar trade, in which he was one of the first to engage. He was one of the original members of the Institute, joining the Natural History Society in 1834, holding a position on some of the important committees, and early sharing the awakened interest in Pomology which made the gardens of Salem so famous forty or fifty years ago, he pushed to its utmost the capacity of his little city-garden. In the Institute exhibitions of those times he was a liberal contributor, displaying pears in sixty odd varieties unexcelled in their waxen comeliness.

See Hist. Coll. Vol. XIV, p. 277.

morning, November 30, 1888. He was the son of John and Mary (Burchmore) Foster, born in Salem, December 23, 1797, and was educated in the district school of his native town. During the war of 1812–15, he was assistant to the United States marshal for the district of Massachusetts. After the war he went to Gloucester to assist his brother; after his brother's retirement from business he returned to Salem and was a clerk in the Boston and Salem stage company. When the Asiatic Bank of Salem commenced business he accepted the position of bookkeeper, in the autumn of 1824; four years later, on the retirement of Mr. J. S. Cabot the cashier, he was appointed to that office which he held till March, 1884, when he resigned having held the office of cashier fifty-six years. He was then appointed cashier emeritus and made one of the directors. These positions he held to the close of life. He was a very able financier, wise and conservative in his investments and conducted the affairs of the bank with integrity, and upon attaining the fiftieth anniversary of his election as cashier, he was honored by the directors of the bank with a handsome testimonial of his honesty and ability. Mr. Foster was the friend of all young men and assisted many to good positions, who have been successful business men and have taken a high rank in the monetary world. He was a man of very progressive ideas. It was his pride that he was one of the original founders of the Salem Gas Light company, and his house was the first private dwelling in Salem lighted throughout by gas. He was also one of the prime movers of the Eastern Railroad corporation, was the first clerk and held the office many years.

He was identified with the Harmony Grove Cemetery corporation from its inception in February, 1837; having been its treasurer and its clerk; looked after its finances; directed about the care of the grounds; the sale of lots; the

endowments made; the laying out of the additional land which has been added to the grounds, and evincing the greatest care and prudence; the clerkship he resigned in February, 1888; the office of treasurer he retained until the close of life. He was a man of generous and charitable impulses; he had been a director in many enterprises in Salem but took particular interest in the association for the relief of the Aged and Destitute Women of which he was president and whose inmates he entertained once a year at his summer home, and in the Bertram Home for Aged Men of which he was a trustee. He was the oldest surviving member of the Salem Cadets in which he was enrolled in 1815, chosen ensign in 1824, and always took an active interest in its affairs. Excepting his pay as cashier, his varied duties were performed without compensation. He was a very genial man, an interesting talker, possessed of a great fund of historic lore about old Salem, which he at times committed to paper for the press, with a ready pen. He has closed a useful and honorable life with a happy and serene old age.

Admitted to membership of Essex County Natural History Society, June 17, 1835.

Samuel Page Fowler died at his home in Danvers, on Saturday morning, Dec. 15, 1888. He was born in Danvers New Mills, now Danversport, Apr. 22, 1800; son of Samuel and Clarissa (Page) Fowler. He had only the limited education of the early country schools; his tastes were literary and scientific, he was a student and close observer of nature.

No person has held a more prominent place in the town affairs of Danvers, social, literary, educational and parochial, than Deacon Fowler.

He was one of those who attended the early meetings

in 1834, for the organization of the Essex County Nat. Hist. Society which afterwards uniting with the Essex Historical Society was incorporated in 1848 as the Essex Institute. He took a deep interest in the success of this institution under its different phases and held various positions in its general management. For a more extended notice of Mr. Fowler see Historical Collections of the Institute, vol. XXVI.

LEONARD BOND HARRINGTON died at his residence, on Federal street, Wednesday evening, Mar. 6, 1889; the oldest leather manufacturer in Salem.

He was the son of Charles Harrington of Watertown, and was connected, through his mother, with the historian of that town; born July 29, 1803, passed his school days in this city. He learned the trade of a tanner in Roxbury, worked for several years as a journeyman tanner and currier, and from his savings was able to establish himself in Salem in 1829, and quickly laid the foundation of a large and successful leather manufactory. During the recent civil war his business interests became more widely extended and increased immensely in volume. He brought up many boys to the business who afterward held positions of prominence in the trade.

He was president of the Bertram Home for aged men in Salem and a trustee of the Salem Hospital, and took an active interest in both institutions.

He was for many years president of the Asiatic National Bank and was connected with monetary and other institutions in Salem and Boston and took a leading part in their management.

Mr. Harrington was a very pleasant and genial man, made friends wherever he went, a man of strong convic-

tions and was always interested in political as well as business affairs.

Admitted to membership Feb. 14, 1855.

George Oliver Harris died at his residence 77 Lafayette street, Salem, Tuesday night, Aug. 21, 1888. Son of Capt. Thomas and Abigail (Chapin) Harris, born in Charlestown, Mass., Mar. 31, 1810.

In early life he was in the counting room of Pickering Dodge, a well-known and distinguished merchant of Salem, having passed some part of his schoolboy days in Switzerland.

Later he went to sea as supercargo or some similar position making voyages to the Fiji Isles, Russia and other ports. Later in life, after residing for a while in New York and in the west, he returned to Salem and was clerk in the Naumkeag Steam Cotton Mills. Afterwards he was employed in a clerical capacity by the firm of N. Thayer and Co. of Boston, his son Walter C. Harris succeeding in that capacity.

Mr. Harris was a man of marked excellence of character; he was not one to aspire to public life or distinctions of any kind.

In all his business relations he exhibited the traits of scrupulous integrity, and in every personal and public relation those of true christianity. He had for a long series of years been a very interested member of the Barton Square Church and Society, and never withheld his contribution to any good work that deserved encouragement either in or out of the denomination with which he was identified. Mrs. Harris who survives her husband was a niece of Rev. Henry Coleman the first minister of the church above named.

The deceased was greatly respected by all who knew him and no person's memory will be more kindly cherished.

Admitted to membership April 5, 1869.

Daniel C. Haskell died on Thursday evening, Nov. 22, 1888, at his house 174 Federal street, Salem.

He was a son of Elijah and Lucy (Collins) Haskell, and was born May 15, 1812.

He was a tanner and currier of the old school, and for years conducted an extensive yard and shop on Mason street. He was also associated with the well-known firm of Varney, Haskell and Co., at one time doing a large business in hides and leather on High street in Boston. He was a man of solid worth of character, modest and retiring, never aspired to public office, but served in the common council in 1854 and 1855. He amassed property and retired from active business some years ago. He was earnest in his interest in the Universalist Church, and prominent in his membership. He became a member of the Essex Lodge F. A. M., June 5, 1855.

Admitted to membership July 6, 1864.

Fielder Israel. Seldom has a death occurred in this city that has caused such universal regret and called forth expressions of regard so general, as that of the pastor of the First Church, on Friday evening, Jan. 4, 1889.

The deceased was eminently genial and companionable, cordial in his greetings to all, and earnest in every good work. He was well known to all classes of citizens and had many friends, for one could not know him except to like him.

Fielder Israel was born in Baltimore, Md., June 29, 1825; son of Fielder and Sarah S. (Sempson) Israel; he

was well-born; the family of Israel of Baltimore was a sturdy people. He received his education at Baltimore and at Dickinson College, Carlisle, Pa. Leaving the latter before his graduation, he entered the ministry of the Methodist Episcopal Church. He received his first appointment as colleague of the late Rev. Robert Cadden, at Fort Royal, Va., in 1845, whose daughter, Elizabeth S., he married at Baltimore, March 28, 1850.

His theological views having undergone a change in later years, he accepted a call to the Unitarian church at Wilmington, Del., where he remained several years. He seemed to have joined the Unitarians, without having left the Methodists; honoring the great leaders of the Methodist reform, Puritans in their way as were the early New Englanders. To the day of his death, he retained his love for his old conference and his former church companions. He was installed pastor of the First Church in Salem, Mass., March 8, 1877.

Since coming to Salem he manifested a strong and liberal public spirit. He took an interest in everything pertaining to the welfare of the community. He was eminently a man of the people. Philanthropic at heart, he practised a broad generosity. He early associated himself with the Essex Institute, was interested in its work; frequently an attendant upon its meetings, taking an active part in the proceedings; was usually on some of the standing committees and frequently placed on those appointed for special purposes. He was a member of the committee of arrrangements on the commemoration of the two hundred and fiftieth anniversary of the landing of John Endicott, at Salem, Sept. 6, 1628, O. S., under the auspices of the Essex Institute.

His reverence and love for the old church of which he was the pastor was most profound, and his views upon the

religious life and teachings of the fathers were frequently expressed in his sermons, and always commanded interest and attention; the two hundred and fiftieth anniversary of its organization, August the first, 1879, was duly commemorated by him with appropriate services. His heart was in his church work; he had meetings with the teachers of the Sunday school; he sought the children; he loved hymns and church music; wherever he went, the methods and doings of the First church had a voice to represent them. As a reader of impressive hymns and stirring verses, he had no superior in this community.

He was a firm believer in the principles of Free Masonry, and became deeply interested in the work of the order, and that interest continued unabated till the last days of his life, a period of thirty-eight years; at the time of his death, he was chaplain of the Grand Lodge of Massachusetts, of Starr King Lodge, Washington R. A. Chapter, Sutton Lodge of Perfection and Salem Council, and until his health failed he was always a regular attendant at the meetings of those bodies.

Admitted to membership, May 21, 1877.

Henry Franklin King, a retired shipmaster of Salem, died at the residence of his sister, Mrs. Charles Hoffman, Chestnut St., Salem, on Thursday morning, Nov. 22, 1888, of Angina pectoris. He was a son of Capt. Henry and Elizabeth (Gould) King,[1] born in Salem, May 6, 1811. His father Capt. Henry King was born at Hudson, N. Y., and was probably descended from Samuel King, who was born in England in 1633; the father William, the mother Dorothea, himself and four other children, sailed from Weymouth, England, for this country March 20, 1635, and settled in Salem.

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[1] Henry King and Elizabeth Gould were married July 22, 1810.

About 1652, Samuel moved to Southold, L. I., married Abigail Ludlam, daughter of William Ludlam, senior, of South Hampton, L. I., and died Nov. 29, 1721. He was buried in the old churchyard at Orient, L. I. His wife died May 17, 1716. Many descendants have settled in that vicinity, and on the banks of the Hudson. Two of the brothers, William and John, were married and remained in Salem.

His school days were passed at the Franklin Academy, North Andover, under the direction of Mr. Simeon Putnam, and at the private school of Mr. Samuel H. Archer of Salem, noted in its day, for good discipline and for preparing young men for the counting room and the active duties of a mercantile business life. After leaving the school, he entered the counting-room of Thomas P. Pingree, Esq.; whilst in this employ he made a business trip to Para, S. A. Afterwards he embarked upon a seafaring life and sailed with Capt. John Bertram in the ship Black Warrior, for Zanzibar, in the employ of N. L. Rogers & Brothers, pioneers in that trade; his father having been a shipmaster, he soon rose to the same position and made voyages to Zanzibar and other ports on the eastern coast of Africa and the adjacent islands; also ports in the Red Sea, continuing in the employ of the Rogers brothers; sailing in the Lady Sarah, Quill, and other vessels. Later he was engaged in freighting, making voyages to New Orleans in the ship Newburyport, of which he was part owner. About 1838, he retired from the sea; June 26, 1839, he became a member of the Essex County Natural History Society, and soon after was placed on the committee on the Mollusca, and continued in charge of that department until the various scientific collections containing some 140,000 specimens were deposited in the East India Marine Hall, under the custody of the Trustees of

the Peabody Academy of Science, according to the terms of an agreement signed May 29,1867, by the contracting parties. Mr. King, being one of the signers, authorized to act for the Essex Institute. Mr. King devoted much time and study in the arrangement and labelling of the specimens according to the approved system at that time. For nearly thirty years this department was kept in good condition, and had greatly increased from a small number of specimens to one of larger proportions by donations and exchange under his fostering care and prudent and discreet management.

During the fifth decade of this century, this city and its immediate vicinity had a goodly array of enthusiastic and successful cultivators of the choicest gifts of Flora and Pomona. Among these the name of Robert Manning stands prominent as the pioneer in the cultivation of fruits, especially the pear. In 1845, Mr. King made drawings of the different varieties of pears that ripened in Salem that season, the time of ripening, the peculiar quality of each, and other data respecting the same were carefully noted; the figures and notes respecting the new varieties as introduced were carefully noted for several years. These various notes and drawings are deposited in the library of the Institute.

In 1852, the late Mr. Thomas Cole presented to the Institute a Pritchard standard microscope with the necessary accompaniments for practical use in the study of the natural sciences, with the view that it might be an incentive to the young student to resort to this aid in his studies. Mr. King familiarized himself with the use of this instrument, and having an artistic taste, made fine sketches illustrative of vegetable growth and structure as discovered through this powerful aid to the vision. Rev. John Lewis Russell, the well-known cryptogamist, availed him-

self of the valuable services of Mr. King in the preparation of illustrations to accompany his papers on the lichens and other vegetable organisms. Some of the illustrations on these subjects are deposited in the library of the Institute.

To show the increased use of the microscope, it might be stated that at a social meeting of the Institute held on Tuesday, May 1, 1866, its object being to bring together all the microscopes that could be easily obtained for the purpose of interesting the friends of the Institute in this department of science, and also to celebrate in an appropriate manner the festival of May-day, Mr. C. M. Tracy, of Lynn, spoke of the wild flowers before him, the precursors of a bloom that is to open on us in the garden, the woodland and the wayside; Prof. O. W. Holmes, of Boston, gave a brief sketch of the history of microscopy and the later improvements in the structure of the microscope. There were on exhibition, thirty instruments in all, comprising twenty-five different styles of manufacture.

Mr. King was a member of the School Committee in 1854–58 (when the City Council elected the School Board). He did good service, frequently visiting the schools and familiarizing himself with all details and showing a great interest in educational matters. He was for several years a trustee of the Salem Athenæum and was an efficient member of the committee on the library.

He was a person of much intelligence, well posted in current events, in the history of our own times, and to some extent in general literature; and, though much retired from general society, was fond of social intercourse and conversation among old friends. He was perhaps more interested in scientific than in purely literary subjects, being a constant lover of science in general, but his attainments in the broad field of philological study, to which he was much devoted at different periods of his

life, brought him an exact knowledge of several of the leading languages, both living and extinct, which is by no means to be overlooked.

Dr. William Neilson one of our venerable and highly esteemed physicians, died, after a brief illness, at his residence in Salem, on Friday morning, May 3, 1889; he was highly appreciated as a successful practitioner, a genial friend, a gentleman of large intelligence; he was one of the staff of physicians at the Salem Hospital from its organization, April 7, 1873, till his death; a valued member of the Crombie street church, also of the Essex Congregational Club and always a constant attendant upon its meetings. As a member of the Essex Institute, he was interested in its work, took part in all its proceedings, and was placed on some of the standing, and frequently upon special committees. He was a gentleman of a kindly heart, and quiet genial manner, and will be missed greatly, not only in his home circle, but in the community at large.

Dr. Neilson was born in Belfast, Ireland, October 1, 1808; son of William and Sarah (Madden) Neilson, both of the county of Antrim, Ireland. His father was a watchmaker and jeweler, and made the snuff boxes of bog oak and diamonds presented by the Prince Regent to the allied sovereigns after the downfall of Bonaparte. His grandfather, Joseph Neilson, an architect, built the bridge of Tuam, and was the grandson, according to family tradition, of a Scotch refugee nobleman who fled to Ireland after the rising of 1715.

The family sailed for Philadelphia in 1818; the vessel was wrecked on the coast of Nova Scotia, in consequence of which their plans were changed, and they settled in Halifax, N. S.

Dr. Neilson returned to Ireland when a young man,

afterwards studied in Edinburgh, and in 1855 took his medical degree at Harvard; in early life being delicate in health, he travelled much in the Brazils and in the countries bordering on the Mediterranean.

During his residence in Halifax, Dr. Neilson was the leader of the little Sandemanian church, but finding that his religions opinions and his unwillingness to take an oath, was a bar to his prosperity there, he removed to Salem about 1861, where he found a pleasant home, and which he liked better than any other place he had seen, except Edinburgh.

Dr. Neilson married Jan. 9, 1838, Susan Allen, born in Dartmouth, N. S., October 13, 1816, died at Salem, Mass., February 21, 1875; she was the daughter of John and Sarah (Stayner) Allen, both of whom, as infants, left Boston, after the evacuation, with their parents who were united Empire Loyalists. They count descent from Cotton Mather, and from Admiral Sir Richard Stayner who, as Captain Stayner of the "Speaker," served under Blake and accomplished the famous cutting out expedition of Santa Cruz, April 19, 1657.

Admitted to membership, January 13, 1864.

Edward B. Phillips, secretary of the Essex Lodge, No. 26, I. O. O. F., was born in Salem, December, 1822, and died April 1, 1889; son of Samuel and Sarah (Carroll) Phillips; occupation, a tailor; initiated an Odd Fellow in Essex Lodge, Feb. 23, 1846; he was installed as secretary in July, 1858, and held this office until the day of his death. He was a man of sterling character and beloved by all who knew him, a faithful officer, and constant attendant at the meetings; his familiar and genial face will long be missed by his many firm friends and associates; he was stricken with apoplexy at his post of duty in the

lodge room, and passed away shortly after without apparent suffering. At the time of his death he was also scribe of Naumkeag Encampment, and secretary of the Salem Charitable Mechanics' Association. He has left a record of faithfulness and fidelity as a lasting monument to the many brothers who may be his successors.

Admitted to membership, March 8, 1854.

John Wayland Roberts died at his residence, 23 Forrester street, Salem, on Thursday morning, Sept. 6, 1888; trader, of the firm of E. F. & J. W. Roberts. Mr. Roberts was born in Peabody, Mass., April 3, 1838, son of David and Susan (Vickery) Roberts. His father was one of the old leather men of Peabody, his residence being on Central street, his tannery and shop adjoining. Mr. Roberts commenced business in Peabody; soon after he formed a partnership with Edward Foster Roberts, and with their united capital they began to transact a business larger than their expectations. About the time of the war, the firm removed to Salem, opening on Essex street, midway between the market and Central street, and, about 1867, they bought out the stand on the corner of Washington and Front streets, and removed thither, occupying the store ever since. Mr. Roberts was a man of quiet and retiring disposition, but exceedingly active, and a very shrewd, careful business man; in addition to their retail department, the firm did a large wholesale trade in fruits, supplying many dealers, not only in Salem, but in the surrounding towns, and by his efforts built up a large and successful business. He was a member of the Essex Lodge, F. A. M., and took a high standing in the order.

Admitted to membership in the Institute, June 9, 1864.

Elijah Packard Robinson, son of Benjamin and Mary

(Packard) Robinson, born in East Bridgewater, Mass., May 19, 1817, died at Saugus, Sept. 2, 1888. He traced his paternal ancestry to Gain Packard,[1] the original settler, who was from Ireland, landed at Plymouth, lived in Braintree, Pembroke, and finally in East Bridgewater, where he died in 1763, aged 81 years. His wife was Margaret Watson, by whom he had Joseph,[2] and other children. Joseph[2] married Abigail Keith, 1746; Benjamin,[3] born 1748, married Eve Packard, 1770; Benjamin,[4] born 1784, the father of the subject of this notice.

At the age of fifteen he shipped at New Bedford on a three years' whaling cruise; the results of his experience and observations during this voyage were embodied in an interesting paper, which he read at a regular meeting of the Institute, March 24, 1882, entitled, "What I know about whaling." From that time until his thirty-third year he followed the sea, in the various capacities on ship-board, from the forecastle to the cabin, going to many of the principal ports of Europe, East and the West Indies, when he met with an accident, which produced a permanent lameness, and thus necessitated a change in the character of his future employment. He was obliged to confine himself principally to the use of the pen; among the positions which he held were a clerkship of twenty-five years in the office of the secretary of state; three years in the Charlestown navy yard, etc., etc., in the meanwhile writing articles for the newspaper press; at a field meeting of the Institute, held in Saugus, Wednesday, Aug. 30, 1881, he gave an account of "The old iron works," Saugus,[1] also "A notice of Saugus seminary," dedicated in 1821.[2] For the five years immediately preceding his death he was a confirmed invalid.

Admitted to membership, Feb. 7, 1876.

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[1]See Hist. Coll. E. I., Vol. XVIII, 241.
[2]See Hist. Coll. E. I., Vol. XIX, 77.

William Crowninshield Rogers, whose death occurred in London, July 2, 1888, was prominently known in Boston business circles. It was only two months previous to this announcement that he closed his house on Commonwealth avenue, Boston, and went abroad for pleasure; his health was no more delicate than usual, and his death came like a sudden blow to his many friends.

Mr. Rogers was the son of Hon. Richard Saltonstall and Sarah (Crowninshield) Rogers, of Salem, and was born in that city, July 26, 1823; he pursued his preparatory studies at the Salem Latin School, then under the charge of Oliver Carlton, and entered Harvard College in 1839; he continued there until the spring of his junior year, when he left and entered the merchant service, being principally engaged in the East India trade. A correspondent sends to the Salem Gazette, Friday, July 6, 1888, the following: "Early in life Capt. Rogers commanded the ship "Thomas Perkins, one of the most lucky ships of Salem, "making a much shorter passage to San Francisco than any "of the ships at that season. He afterwards commanded "the famous clipper Witchcraft, trading between Boston, "San Francisco and China, and in all these voyages he "was eminently successful."

On the breaking out of the rebellion, he was among the first to enlist, and saw much service, being stationed for some time in the Gulf of Mexico.

His war record.—Vol. Lieut. U. S. N., August 12, 1861; ordered to command the U. S. bark W. G. Anderson, August 12, 1861; cruised in the West Indies; detached and ordered to the command of U. S. S. Huntsville, April 21, 1862; in Eastern Gulf Squadron; command of U. S. S. Iuka, Feb. 11, 1864; Vol. Lieut. Commander, Oct. 24, 1864; Eastern Gulf Squadron; detached and ordered on shore duty, June 15, 1865, until July 16, 1866. Resigned July 18, 1866.

Sometime previous to the breaking out of hostilities, he had given up active business, and at the close of the war he did not attempt its renewal. Always a sufferer from lung troubles, he was obliged to take great care of himself.

He married, July 6, 1871, Mary Ingersoll Bowditch, daughter of Nathaniel Ingersoll and Elizabeth Brown (Francis) Bowditch, born in Boston, Sept. 4, 1838; died at Funchal, Island of Madeira, Sept. 26, 1874, leaving one child, William Bowditch Rogers, born at the Island of Madeira, Sept. 14, 1874, who was with his father in London at the time of his death.

In 1865, he received from Harvard college the degree of A. B., and his name is enrolled among his college classmates of 1843.

By extensive travels and observation, combined with his natural abilities, Mr. Rogers became a most congenial companion, and had many warm friends in this vicinity. The country has lost a worthy patriot, and those who knew him, a sincere friend.

Admitted to membership, March 11, 1857.

Francis Willis Tuttle died at his residence, 6 Hathorne street, Salem, on Saturday morning, Nov. 10, 1888. He was born in Salem, October 19, 1815, son of Willis and Sarah (Grant) Tuttle.

For upwards of forty years he had been in the dry goods business on Essex street; when a boy he entered the employment of the late Thomas W. Downing. Some years after he reached manhood, he entered into partnership with John Hammond, under the firm name of Hammond & Tuttle; in later years he succeeded to the entire business. He was long identified with the Salem Light Infantry and had been a lieutenant in that corps, and was a member of the S. L. I. Veteran Association, took a great interest and held an official position in that organization. Mr. Tuttle

was a good citizen, modest and unassuming, and an honorable business man.

Admitted to membership, July 6, 1864.

Aaron Wood Warren died at his home in Danvers on Sunday morning, Feb. 19, 1889. He was a son of Jonas and Hannah (Kimball) Warren and was born in Danvers, Oct. 13, 1818.

His father, Jonas Warren, was son of Jonas and Aphia (Stickney) Warren, and was born in North Beverly, July 29, 1787. About 1790 the family removed to Boxford, and Jonas was brought up by his uncle Ancil Stickney;[1] he afterwards came to Danvers and soon found a place of usefulness in the store kept by Deacon Gideon Putnam, corner of High and Elm streets, at the Plains; in a few years he bought the establishment, and by his industry, broad and far-sighted manner of doing business, transferred a mere country cross road into a busy commercial centre.

In 1841, he sold out at the Plains and removed to the Port, where he became the pioneer in the wholesale flour and grain business, entering into the large field with the same energy and sagacity that he had displayed in previous operations. He was the first to bring grain to the Port by water, and from the cargoes of many vessels coming and going, supplied a very extensive inland trade.

He was a director of the Naumkeag National Bank, Salem, from its organization until his death, at the age of nearly ninety years, which occurred Nov. 18, 1876. He

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[1]Captain Ancil Stickney, born June 3, 1762, was son of Jedediah and Margaret (Tyler) Stickney. He lived in the old Stickney mansion in Boxford; married there, June 27, 1793, Mehitable, daughter of Nathaniel and Mehitable (Perley) Perley of Boxford; born there April 9, 1767, and died Oct. 22, 1837. He died in Boxford, March 27, 1835, leaving no children. The homestead, that had been in the family for about one hundred and ten years, has passed out of the name.

was considered one of the best business men who ever lived in Danvers.

His mother, Hannah Kimball, born in Boxford, March 23, 1787, was a daughter of Enoch and Huldah (Gould) Kimball, a farmer.

Formerly, for many years, Mr. A. W. Warren carried on the wholesale grain and retail grocery business in the brick block at the Port. Some years since, having realized a competency, he retired from active business. He married, Nov. 24, 1844, Hannah P. Woodbury, who with their only daughter, Anna Phippen Warren, survives.

Like his father he kept aloof from the arena of politics, and had not held any public office. The business relations of the father and son with the public had been such that scarcely any persons were more widely known or more respected and honored in the county of Essex than Jonas Warren and his son, the subject of this notice. Their strict integrity secured the confidence of all, and they have left to their family a legacy of an untarnished name.

Admitted to membership, July 17, 1867.

William Low Weston, born in Brooklyn, Pa., April 17, 1817, died in Danvers, Mass., Feb. 1, 1889. His father, Samuel Weston, removed from Brooklyn, Conn., to Pennsylvania. The town in Pennsylvania was named from the town in Connecticut. His mother, Julia Horton, was daughter of Foster Horton, whose father was a Presbyterian minister of Bottle Hill, N. J. He received his early education in Baltimore, Md., and later, being of studious habits, he pursued his studies by himself. He came from Boston to Danvers in 1841, and was appointed cashier of the Village, afterwards the First National, Bank, and succeeded Samuel B. Buttrick, the first cashier; he held this position until 1884, when he was succeeded by

the present cashier, B. F. Newhall. He married Louisa Page, of Danvers, July 5, 1844. In 1850, he petitioned the legislature for the charter of the Danvers Savings Bank, and was appointed the first treasurer, and to his earnest efforts the success of the bank is largely due; he resigned his position in 1884, and was followed by Israel H. Putnam; he was town treasurer for twenty-eight successive years, resigning in 1881 or 82. He was the first treasurer of the Gas Light Co., organized in 1860, and was conspicuously identified with the building of the Essex R. R. to Lawrence. He was also one of the earliest and most influential advocates for the introduction of the Middleton water into Danvers, and, as treasurer, negotiated the sale of the bonds to pay the cost of the works. During all his residence in Danvers, he was closely identified with the best interests of the town, and has been one of its foremost citizens, filling these many important positions and filling them well. Few amongst men have been more implicitly trusted.

Admitted to membership July 16, 1866.

Frederick Winsor, a well known resident of Winchester, Mass., died at Hamilton, Bermuda, Feb. 25, 1889, whither he went with a view to the restoration of his health, which had been failing for some months. The immediate cause of death was pneumonia, and in accordance with his own request, he was laid to rest on the lovely shores of Bermuda.

Dr. Winsor was born in Boston, Oct. 2, 1829; son of Thomas and Welthea (Sprague) Winsor. He pursued his preparatory studies in the Boston Latin School, graduating in the class that entered that school in 1842; he brought to the college a thorough preparation and scholarly habits, and was graduated at Harvard in the class of 1851, and at

the Harvard Medical School in that of 1855. In the same year he established himself in Salem, where the earlier years of his married life were spent, and where he secured, at once, the reputation of a skilful, honest and judicious practitioner; he also identified himself with several of the institutions that had been organized in Salem for the promotion of the arts, sciences, literature and general culture, doing good work and largely extending the sphere of their operations for usefulness and progress.

In 1861, he received from Governor Andrew an appointment over the State Hospital at Rainsford Island; leaving Salem with many regrets from his friends there, he took up his residence at the island, where he did excellent work, until in 1862, when the demand for skilled medical service in the war took him into the field; he enlisted in the 49th (Mass.) Regiment, and served through the Louisiana campaign of the next year. The record of his services in the war is as follows: Surgeon, 49th Mass. V. M., Nov. 21, 1862. In camp at Long Island, N. Y.; sailed for New Orleans, La., Jan., 1863; moved to Baton Rouge, La., Feb. 17, as part of Gen. Augur's Div. 9, A. C.; marched to Port Hudson, La., May 20, and engaged in its siege May 22–July 5; by boat to Donaldsonville, La., July 6; mustered out, Sept. 1, 1863.

In 1864, after a few months' residence in Cambridge, he established himself in the pleasant town of Winchester, where the remainder of his life was spent, characterized by a devotion to conscientiousness, fidelity, professional ability, industry and public spirit. He had an extensive practice and was considered one of the most prominent citizens of the town; served on the school committee, was on the town hall building committee, a director of the savings bank, and for many years a medical examiner for Middlesex county. As to his professional position, there was

no one more highly esteemed by his associates in the profession. His contributions to medical literature, such as his reports to the State Board of Health upon "The Hygiene of School Houses," in 1874, and upon "Water supply, drainage and sewerage from the sanitary point of view," in 1876, are regarded by the profession as among the most valuable results of the sanitary studies of these later days.

Dr. Winsor was an essential factor in the organization of the Unitarian church and society in Winchester, which took place in November, 1865, when twenty-six of his neighbors met by his invitation in his parlors, to hear one of his personal friends conduct the simplest of religious services. He stood in the closest relations and singular sympathy with the first pastor, Rev. Richard Metcalf, and thus was secured the future of liberal christianity, and for more than twenty years his time and wisdom have been devoted to the cause of the church. For twenty-one successive years he was a member, and most of this time chairman, of the standing committee, and also superintendent or assistant superintendent of the Sunday School; always ready to give a lifting hand at the right time and in the right place. The departure of such a man is a great loss to any community.

Admitted to membership, April 4, 1855.

BULLETIN

OF THE

ESSEX INSTITUTE,

VOLUME XXII.

1890.

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BULLETIN

OF THE

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ON THE SPECIES OF THE GENUS CHALCINUS IN THE MUSEUM OF COMPARATIVE ZOOLOGY AT CAMBRIDGE, MASS., U. S. A.

BY S. GARMAN.

THE Thayer Expedition of Professor L. Agassiz and his party, to Brazil, collected a large number of duplicate specimens of species of Characinidæ. In preparing these for distribution to the correspondents of the Museum they have been identified from the original descriptions with results that do not agree with others of recent publication. As a consequence of disagreement with the constitutions of the genera as heretofore accepted, it is thought advisable to publish the conclusions in this place.

There are several general features of Chalcinus that deserve a few words of notice before dealing with the separate species. The labial folds and the barbels are present on each of the various forms, with the possible, but unlikely, exception of *C. paranensis*. The latter is known to me only by the description, yet it agrees so closely with

the short variety of *C. angulatus* that absence of the features mentioned would be rather unexpected, and if present, as I have no doubt they are, they should be placed among the generic characters. There are two series of intermaxillary teeth in young specimens. On the other hand, old specimens apparently have three more or less perfect series in the same region. This difference in individuals of the same species is brought about somewhat as follows: the third tooth of the inner row on each side of the symphysis is crowded outward to take a position between the two rows; then, as the growth of the specimen continues, the first tooth on each side of the middle of the outer row is crowded inward, the third tooth of each section of this series afterward follows in the same direction, and still later the fifth tooth shows a disposition toward similar displacement, thus eventually producing what might be described as a triserial arrangement of the intermaxillary teeth. The amount of curvature from snout to tail, in the dorsal outline, as given in descriptions is to be taken with some allowance; it varies greatly with the age and degree of plumpness of the individual and also changes in death and in alcohol. Including several varieties, the following species seem to be all that can be recognized at present.

Scales from upper edge of gill opening to caudal 30–40;
- rays in the anal fin 24 (23) . . . *C. pictus.*
- rays in the anal fin 28–33;
  - from dorsal to lateral line 6 scales;
    - lateral line of 32 scales . *C. paranensis.*
    - lateral line of 33–40 scales *C. angulatus.*
  - from dorsal to lateral line 5 scales;
    - base of anal extending beneath that of dorsal;
      - form short and deep . *C. güntheri.*
    - base of anal behind that of dorsal;
      - form elongate . . . . *C. albus.*

Scales from upper edge of gill-opening to caudal 40–47 ;
rays in the anal fin 27–32 ;
first anal ray behind the dorsal . *C. elongatus.*
rays in the anal 30–34 ;
first anal ray beneath middle of dorsal *C. culter.*
rays in the anal 35–41 ;
first anal ray in front of dorsal *C. magdalenæ*

CHALCINUS ANGULATUS Spix and Ag. ; C. V.
C. brachipomus C. V.
C. mülleri Fil.
C. trifurcatus Cast.
C. nematurus Kn.
Triportheus flavus Cope.

Valenciennes states in his description of *C. brachipomus* that the length is about three and a half times the height and nearly five times the length of the head, which proportions, together with the characters assigned it, seem to necessitate placing it as a synonyme with *C. angulatus*. *C. brachypomus* of Günther is so different in essential respects from that of Valenciennes that the two cannot be considered identical. On typical specimens of *C. angulatus* the labial folds and the barbels are short, apparently ; in this and in the other species, they are longer in the young than in the old, and it may be they are the more developed in the spawning season. One of the varieties has a length of barbel that equals or exceeds the diameter of the eye. Examination of a large number of specimens discloses no variation in the number of scales (6) between the first ray of the dorsal and the lateral line. Hab. Coary, Cudajas, Fonteboa, Hyavary, Iça, Jutahy, Lake Hyanuary, Lake José Assu, Manacapouru, Manaos, Obydos, Santarem, Silva, Lake Saraca, Tabatinga, Teffé, Tonantins.

The species as represented in the collection is separable into four varieties beside the type form.

1. *C. curtus.* Distinguished by the shortness of its body and the roundness of its outlines, its depth being more than one-third of its length, without the caudal. The localities indicated are Pará and Arary.

2. *C. vittatus.* Marked by the possession of two or more longitudinal bands on the flank, formed by a spot of dark color about the middle of the posterior border of each scale in the row. Commonly there is a patch of brown near the base of the pectoral. Taken at José Fernandez, Villa Bella, Porto do Moz, and Santarem.

3. *C. signatus.* The bands are absent from the flanks of this form; it is darker on the upper surface than the preceding; the fins are darker on their edges, and there is a transverse band of light color on the caudal. The flanks are silvery. Hab. Rio Puty.

4. *C. fuscus.* On this form the back is very dark; the sides have a golden reflection but the scales are broadly margined with brown on their free edges which makes the fish appear dark colored. Top of head, lips and barbels nearly or quite black. Fins, brownish. Barbels, as long as the eye. From Villa Bella and Lake Hyanuary.

CHALCINUS PARANENSIS Gthr.

D. 11, A. 30, L. l. 32.

According to the description this species has thirty rays in the anal fin, thirty-two or thirty-three scales in the lateral line, six scales between the latter and the first ray of the dorsal, and the length without the caudal is equal to two and two-thirds times the height or four times the length of the head. Described from the Parana river.

CHALCINUS GÜNTHERI nom sp. n.

C. brachypomus Gthr.

D. 11, A. 28, V. 7, L. l. 34.

In this species there are but five scales in a series between

the first ray of the dorsal and the lateral line, and between the latter and the ventral but a single one. Taking one from the San Francisco river as a typical specimen, it is found to have thirty-two rays in the anal, thirty-one scales in the lateral line, counting those on the tail with the others, and its length is about two and one-half times its height or nearly three and three-fourths times the length of the head.

CHALCINUS PICTUS sp. n.

D. 11, A. 24 (23), V. 7, L. l. 32, L. tr. $\frac{5}{1(2)}$.

This species may be classed with the angulata group. Though not quite as slender as the next in order, it bears some resemblance in shape.

A specimen from Jutahy, of five and one-eighth inches, has a length of three times the height or four times the length of the head. There are five scales between the first ray of the dorsal and the lateral line, one between the latter and the ventral, and two between the lateral line and the lower edge of the body. Barbels small; labial folds well marked; intermaxillary teeth in two slightly irregular series. Eye moderate; its diameter is more than one-third of the length of the head and nearly twice the length of the snout. Head rather broad, not very convex between the orbits, which latter are little narrower than the interorbital space. The base of the anal begins a little distance behind the end of that of the dorsal.

Color, in alcohol, golden, lateral edges of scales brownish, top of head light, back little darker. A triangular patch of brown is seen on the pectoral fin, near the base; behind this there is a band of light color, parallel with the posterior border, which is narrowly edged with dark. The middle rays of the caudal are dark; on each side of this dark band there is a light area in front of a transverse black band on the extremity of the fin.

Chalcinus albus.

Triportheus albus Cope, juv.
Chalcinus Knerii St., adult.

D. 11, A. 29–32, L.l. 30–33.

Five scales between the first ray of the dorsal and the lateral line were present on all the specimens examined. The anal fin begins at a little distance behind the base of the dorsal. The middle rays of the caudal are not black as in the preceding; the extremity of the fin is crossed by a black band, in front of which there is a white one.

Secured at Manacapouru, Porto do Moz, Tabatinga, Tajapura, Teffé, Rio Negro, Hyavary and Içá.

Chalcinus elongatus Gth.

"D. 11, A. 28, V. 8, L. l. 45, L. tr. $\frac{6\frac{1}{2}}{3}$."

A considerable variation is to be seen in regard to the amount of convexity of the crown; on the young or on the lean it is much less than on the more plump of the older ones. The barbels are more prominent on the young. The anal rays vary in number from 28 to 32, the scales in the lateral line from 43 to 48, and the scales between dorsal and lateral line from 6 to 7. Next to *C. angulatus*, this species is probably the most common. It was taken at Arary, Cameta, Gurupa, Içá, José Fernandez, Jutahy, Lago Alexo, Lake Hyanuary, Lake José Assu, Manacapouru, Manaos, Montalegre, Obydos, Pará, Porto do Moz, Rio Negro, Santarem, Silva, Lake Saraca, Tabatinga, Teffé, Tonantins and Villa Bella.

Chalcinus magdalenæ St.

"D. 11, A. 35–41, V. 7, L. l. 41."

Six and a half to seven rows of scales above the lateral line, and one and a half rows below it to the ventral, or

three to the lower edge of the body. In this species the base of the anal extends forward to or beyond a vertical from the front extremity of that of the dorsal. Hab. Magdalena, Cauca, Guayaquil.

Chalcinus culter Cope.

D. 11, A. 31–36, V. 7, L. l. 44–48.

There are seven scales above the lateral line to the median line on the back. Localities, Içá, Saô Paolo, Teffé.

ON SPECIES OF GASTEROPELECUS.

BY S. GARMAN.

Gasteropelecus sternicla L.; Pall.

From a Surinam specimen the formula is D. 11, A. 34, L. l. 33, pores 17, D. to A. 14. Numerous specimens from Tabatinga, Lago Alexo and Pará, adult and young, agree closely with this. In the lateral line there is a variation of about three scales, 31–33. Very young ones have minute dots of black pigment in a band on each flank nearly or quite to the head, and in another along the entire lower edge at the base of the anal; they are also more or less thickly sprinkled along the back, over the body and under the chin. Large specimens show similar markings, but, being darker, their marks are less distinct. Specimens from Curupira and Cudajas indicate a wider range of variation: D. 11–12, A. 33–37, L. l. 30–35.

Gasteropelecus stellatus Kn.

D. 14–16, A. 39–42, L. l. 20–22.

A large series of specimens were preserved at each of the following localities: Coary, Hyavary, Manacapouru, Montalegre, Obidos, Saô Paolo, Tabatinga, Teffé and Villa Bella. An individual from Paraguay has D. 15, A. 42, L. l. 21, which does not distinguish it from those of the Amazon. A common mark of the species may be seen in

a brown spot on the anterior rays of the dorsal, and another in the brownish color of the interior or central rays of the pectoral.

Gasteropelecus pectorosus sp. n.

D. 15–16, A. 36–40, L. l. 21 (19–22).

The specimens to which this name is given are readily separated from the preceding by the difference in shape. In those of equal length, when compared with *G. stellatus*, *G. pectorosus* is found to be one-fifth deeper from back of head to lower edge of sternal expansion, the anterior edge of the latter approaching the vertical and being more nearly straight. Or, if specimens of equal depth are compared, *G. stellatus* is seen to be one-third the longer. As far as may be determined from the description of *G. securis*, of Filippi, its shape approaches that of *G. pectorosus;* the former is possessed of a larger number of rays (44) in the anal fin. In the latter the pectorals reach farther back than the base of the dorsal. Measurements from those taken at Manacapouru make the length of one, to base of caudal, two and one-fourth, and the depth one and seven-eighths inches. Of another, the length is one and seven-eighths inches and the depth one and one-fifth. Secured at Cudajas, Lago Alexo, Obidos, Tabatinga and Manacapouru.

Gasteropelecus fasciatus sp. n.

G. strigatus St.

D. 10, A. 25–27, L.l. 30–32.

The outline of this fish is similar to that of *G. sternicla* but it is readily distinguished by its markings. Along the anal margin at the base of the fin there is a narrow band of dark color; parallel to this and half way to the base of the pectoral there is a broader band of similar color;

a third band parallel with the other two passes through the base of the pectoral from the breast to the lateral line; and a narrow stripe of light color edged with darker, extends along the vertebral column on each flank. Usually there are several indistinct spots of darker color on the back, above the light stripe, one of which is situated at the hinder end of the base of the dorsal. A couple of short streaks of dark from the chin appear to meet in an acute angle just behind the eye. The thoracic bands are separated from each other by bands of light color equally wide. In coloration this form resembles to some extent *G. strigatus* of Günther which is said to have four blackish bands on the thorax, radiating from the middle of its convex edge, in addition to a blackish band along the base of the anal fin, and the formula is D. 9, A. 27, L.l. 25. A large number of specimens have been examined, but without discovering one on which there were less than thirty scales in the lateral line. Specimens from Lake Saraca have faint markings, those from Cudajas have them more distinct, but yet appearing faded, while the darkest and most vivid are on those from Manacapouru and Tabatinga.

ON SPECIES OF CYNOPOTAMUS.

BY S. GARMAN.

Cynopotamus gibbosus L.; C. V.

Search for variation in the number of dorsal rays proved without avail, the number eleven is very constant. The range of variation in the anal includes about ten rays, 50–60. The scales in the lateral line vary from 57–62; in the transverse series between the first ray of the dorsal and that of the anal there are usually sixteen scales above the line and fourteen below, rarely fifteen above and thirteen below. The humeral and the caudal spots also vary greatly, being more often present on the young; sometimes they are absent entirely on specimens from localities whence the greater number are well marked. Collected at Coary, Cudajas, Içá, Javary, Jutahy, Lake Hyanuary, Manacapouru, Manaos, Obydos, Porto do Moz, Rio Negro, Serpa, Silva, Lake Saraca, Surinam, Tabatinga, Ueranduba and Villa Bella.

Cynopotamus pauciradiatus.

Anacyrtus pauciradiatus Gth.

A considerable number were received from Lago do Maximo and Villa Bella. On those of a couple of inches in length, the spots on shoulders and tail are distinct. The rays in the anal vary from 44 to 46; the scales in the lateral line from 55 to 57; and in the transverse line be-

tween the anterior rays of dorsal and anal there are commonly 12 scales above the line and 12 below; an occasional specimen reaches 13.

Cynopotamus molossus Kner.

On such as were examined the formula stood as follows: D. 11, A. 43–47, L.l. 46, L.tr. $\frac{11-12}{10}$. Humeral and caudal spots distinct on the numerous small specimens from Serpa and Jutahy.

Cynopotamus microlepis.

Epicyrtus microlepis Rht.

On specimens from Obydos there are fifty-seven rays in the anal, ninety-seven scales in the lateral line, and in the transverse series there are twenty-four above the line and twenty-three below it.

Cynopotamus affinis.

Anacyrtus affinis Gth.

Anal rays varying from 53 to 57, scales in the lateral line from 73 to 80, and in the transverse series between dorsal and anal there are 20 to 22 scales above the line and 17 to 19 below it. Humeral and caudal spots small to absent. Collected at Içа, Coary, Javary, José Fernandez, Jutahy, Lago Alexo, Lake Hyanuary, Lake Saraca, Manacapurua, Saô Paolo and Serpa.

Cynopotamus myersii.

Rœboides myersii Gill.

D. 11, A. 51–56, L.l. 88–95, L.tr. $\frac{24-26}{21-23}$.

From the number of specimens collected and the localities this would appear to be one of the most widely distributed and plentiful of these fishes. Hab. Coary, Fonteboa, Javary, Jutahy, José Fernandez, Lago Alexo,

Lake Hyanuary, Manacapoura, Rio Puty, Saô Paolo, San Gonçallo, Serpa, Tabatinga and Tonantins.

Cynopotomus xenodon Rht.; Ltk.

D. 11, A. 50, L.l. 66, L.tr. $\frac{16}{14}$.

In shape and markings the specimens placed under this name closely resemble *C. pauciradiatus*. The rays in the anal vary from 48 to 55, the scales in the lateral line from 61 to 70, and those in the transverse series from 14 to 16 above the line and from 13 to 14 below it. Large numbers were taken at Lake Saraca and at Serpa; it was also secured at Arary, Lago Alexo and Obydos.

Cynopotamus guatemalensis.

Anacyrtus guatemalensis Gth.

On a couple of a number of individuals from the Chagres river, the formula is D. 11, A. 48–50, L.l. 83–90, L.tr. $\frac{19-21}{21-23}$. The depth of the body is about two and three-fourths times and length of the head four and one-third times in the total length, without caudal.

Cynopotamus knerii.

Anacyrtus knerii St.

D. 11, A. 46, L.l. 86, L.tr. $\frac{17}{15}$.

Small specimens from Tabatinga have a distinct caudal blotch but are without the humeral spot. The silvery band on the flank is narrow but well defined.

Cynopotamus humeralis C. V.

Near the middle of its length the silvery band of the flank occupies the six scales immediately above the lateral line. The humeral and the caudal spots vary much in depth of color, usually both are present. The number of

rays in the anal vary from 42 to 46. Hab. Rosario, Goyaz, and Saô Paolo.

Cynopotamus biserialis sp.n.

D. 11, A. 47, V. 8, P. 13, L.l. 62, L.tr. $\frac{13}{11}$.

Both upper and lower jaws without external toothlike processes; no canines; teeth conical, in two series on intermaxillaries and on the anterior halves of the mandibles; a single series of maxillary teeth. The two series of teeth on the mandibles serve as a ready means of distinguishing this species from *C. gibbosus*, and *C. pauciradiatus*, which it approaches in shape. The back is elevated, decurved toward the occiput, and the depth is one-third of the length to the bottom of the caudal notch. The head is a little more than one-fourth of the length, excluding the caudal. Eye large, two and two-thirds times in length of head, wider than interorbital space. The maxillary nearly or quite reaches a vertical through the centre of the eye. The fourth or fifth ray of the dorsal fin is in the middle of the entire length, without the caudal, and the anterior ray of the dorsal is slightly behind that of the anal. Flanks silvery, humeral and caudal spots present. Many examples were secured by the Thayer Expedition at Lago do Maximo, Obydos and Villa Bella.

ON THE SPECIES OF THE GENUS ANOSTOMUS.

BY S. GARMAN.

THE characteristics of the various fishes credited to it are such as to divide the genus Anostomus into three comparatively distinct groups or subgenera. The large series collected by the Thayer Expedition for the Museum of Comparative Zoölogy illustrate this to advantage, and at the same time they furnish several types that do not appear to have previously been noticed by ichthyologists. The first of the groups (*Anostomus*) is characterized by an elongate narrow snout, of which a cross section in front of the eyes would be nearly round, by a mouth turned almost directly upward and by long, slender, crenulate mandibular teeth. It contains but two of the species. The second group, to which the name *Schizodontopsis* is given, is marked by a short broad snout, of which a transverse section behind the nostrils would be sub-elliptical; by a mouth turned obliquely upward and forward, and by teeth on the mandible that are broad and truncate, having entire or chisel-shaped edges. Four species of close affinities are to be included in this group. The third of the sub-genera (*Schizodon*) is similar to the second in shape of snout, but the mouth is directed forward or, in one species, obliquely downward, and the mandibular teeth are short, broad, and crenulated. This section includes the six remaining species. The characters assigned *Schizodon sag-*

ittarius will not permit its admission. Apparently it is the young of *Rhytiodon argenteo-fuscus*. The fourth tooth on each side in that species is very small and from its position against the third is not readily discovered. The teeth of the species of Rhytiodon differ considerably, and Kner's figures of those of *R. microlepis* do not well represent those of *R. argenteo-fuscus*, which latter agree somewhat well with those of *S. sagittarius* as described. Aside from the six teeth on the mandible there is nothing in the description that will separate *sagittarius* and *argenteo-fuscus*. The differences between Rhytiodus and Anostomus seem too great to allow of bringing them together as subgenera.

In the following table are indicated the different divisions of the genus Anostomus with their contents.

Snout elongate, narrow, sub-circular in cross section;
  mouth directed upward, lower teeth long, narrow, crenulate . . (ANOSTOMUS).
    series of scales 4 from L.l. to D.;
      flank with two longitudinal bands *salmoneus*.
    series of scales 6 from L.l. to D.;
      flank with two or more spots . *trimaculatus*.
Snout broad, sub-elliptic in cross section;
  mouth directed obliquely upward and forward, lower jaw longer;
    lower teeth broad, truncate or chisel-shaped (SCHIZODONTOPSIS).
      series of scales 5 from L.l. to D.;
        a band along the flank . . . *tæniatus*.
      series of scales 6 from L.l. to D.;
        a band along the flank;
          transverse bands none . . *proximus*.
          transverse bands four . . . *varius*.
      series of scales 7 from L.l. to D.;
        a band along the flank . . . *orinocensis*.

mouth directed forward, lower jaw little if any longer;
lower teeth short, broad, crenulate (SCHIZODON).
series of scales 4 from L.l. to D.;
transversely banded with brown;
bands 3, a caudal band . . *vittatus.*
bands 4, a caudal spot . *fasciatus.*
bands blotch-like, no caudal spot *dissimilis.*
series of scales 6 from L.l. to D.;
transverse bands absent;
rows of scales 5 between L.l. and V. *isognathus.*
rows of scales 4 between L.l. and V. *platœ.*
mouth directed obliquely downward and forward, lower jaw shorter;
series of scales 5 from L.l. to D. . *nasutus.*

(*Anostomus.*)

ANOSTOMUS SALMONEUS Gron.

Without a specimen of this species at hand it is not possible to give the characters of the teeth, these having been unnoticed by previous writers. If they agree with those of the following species, as may be expected, the crenulation will be added to the distinguishing characteristics in the diagnosis of the subgenus.

ANOSTOMUS TRIMACULATUS Kn.; Gth.

Mouth directed upward; snout elongate, nearly round in transverse section in front of the eyes, about twice the length of the eye; teeth crenulate in both jaws. The formula as taken from a specimen from Gurupa is D. 12

(13), A. 11, L.l. 45, L. tr. $\frac{6}{5(7)}$. Between the lateral line and the first ray of the dorsal there are six series, and between the line and that of the ventral but five entire series, or seven between the line and the median row of the belly. The depth of the body is three and three-fourths, and the length of the head four and one-fourth times in the total length, excluding the caudal. In the length of the head the diameter of the eye is contained four and one-half times. The fifth, or the sixth, ray of the dorsal is over the middle of the length of the body. A spot is present on the flank below the dorsal, another is seen at the base of the caudal, and there are faint indications of narrow transverse bands on the back, from the occiput to the end of the dorsal fin. Opercle unspotted.

(*Schizodontopsis.*)

ANOSTOMUS TÆNIATUS Kn.; Gth.

In all the species of this group the mouth opens obliquely upward and forward, the snout is broad in front of the eyes, and the teeth of the lower jaws are truncate or nearly entire on their cutting edges. On this species there are five series of scales between the lateral line and the dorsal, and four from the line to the ventral or five to the median series of the belly. One specimen, from Lake Hyanuary, has but four series between the line and the ventrals; in other respects it is normal and agrees with its fellows of the same locality. There are eight rays of the dorsal in front of the middle of the body. Depth of body and length of head are equal and each is contained four and three-fourths times in the length of the body.

Numerous examples from Cudajas, Iça, Jutahy, Lago Alexo, Lake Hyanuary, and Lake Saraca.

Anostomus proximus sp. n.

D. 12–13; A. 10–11; V. 9; L.l. 45; L. tr. $\frac{6}{5(6)}$.

Rather more stout than the preceding, but similar in general outline and markings. Mouth opening obliquely upward and forward, lower jaw longer, lower teeth truncate, upper crenulate. Snout about one and one-fifth times as long as the eye. Length of head and depth of body nearly equal, about two-ninths of the total length, without the caudal. The eighth ray of the dorsal is close upon the middle of the length. The row of scales from the first ray of the ventral toward the dorsal strikes the hindmost ray of the latter.

Brownish, rather dark, with a band of darker from snout to tail below the lateral line.

Closely allied to *A. tæniatus* from which it may be distinguished by the smaller, more numerous scales.

Hab. Villa Bella and Ueranduba.

Anostomus varius sp. n.

D. 12–13; A. 11–12; L.l. 45–48; L. tr. $\frac{6}{5(6)}$.

Depth of body, or length of head, contained four and one-third times in the length, without caudal. Much stouter than *A. tæniatus* of the same length. Mouth opening obliquely upward and forward, eight teeth in each jaw, upper crenulate, lower truncate. Back brownish, centers of scales lighter and silvery, belly silvery. A brownish band from snout to tail, below the lateral line, ending in a black spot. The band is rather indistinct, and often obsolete. On the flank there is a transverse band of brownish behind the base of the pectoral, a second from base of dorsal to that of ventral, a third behind the dorsal, and a fourth in front of the soft dorsal. The color is us-

ually darker at the points of intersection of the longitudinal and the transverse bands. The latter are frequently indistinct, even on very young specimens. On large ones the depth is less than four and the head rather more than four and a half times in the total length, and the markings are greatly faded; some have the longitudinal bands more distinct, others the transverse, and on a few all of the bands, including the caudal spot, are obsolete. Eight or nine of the dorsal rays are in front of the middle of the length. The peculiar coloration, squamation, and stouter form serve to distinguish this fish from either of the two preceding species of this subgenus.

Hab. Gurupa, José Fernandez, Lake Hyanuary, Manaos, Obydos, Porto do Moz, Rio Negro.

Anostomus nitens.

A. varius, var. n.

This name is given to a dozen light colored specimens from Içá. The transverse bands of the flank are reduced to blotches on the lateral line, the longitudinal line is faint or absent, and the general appearance is greyish rather than brown. The back is crossed by numerous narrow streaks, twenty-eight on one specimen, separated by lighter spaces of equal width. The lateral series of blotches is present on eight of the lot, while on the other four they are obsolete, excepting the caudal spot which is much faded. The eye is large, equal to three-elevenths of the length of the head, or to the length of the snout. Nine rays of the dorsal appear in front of the middle of the length.

Anostomus orinocensis St.

In the description of this fish it is said there are seven scales between the lateral line and the dorsal, and three and a half between the line and the ventral; the latter

statement is probably a mistake, since in the figure given there are six. The species is nearer to *proximus* and *varius* than to *tœniatus*.

(*Schizodon.*)

ANOSTOMUS VITTATUS C.V.; Gth.

D. 12; A. 11; L.l. 44; L. tr. $\frac{4}{4(5)}$.

This species is closely allied to *A. fasciatus*. It is a trifle less slender. The general appearance is darker; of the bands across the flank the three anterior occupy the same positions, but the fourth has given place to a longitudinal band extending back to include the caudal spot. The snout is one and a half times the diameter of the eye. In the length of the body, without the caudal, the depth is contained three and four-fifths times, or the length of the head four and two-thirds times. The middle of the length is below the ninth dorsal ray. The mouth opens forward. The jaws are equal, and the teeth are crenulate in both.

Hab. Porto do Moz; Goyaz.

ANOSTOMUS FASCIATUS Sp. and Ag.; Gth.

This species is very close to the preceding. Aside from being more slender, the main dependence in distinguishing it is to be placed on the coloration, as the formula is about the same for each. The tenth ray of the dorsal is nearly over the middle of the length, in which the depth is contained four and one-third and the length of the head four and two-thirds times. The mouth opens forward, the jaws are nearly equal, and the teeth are crenulate in upper and lower. The snout is about one and one-fourth times the diameter of the eye. Collected at Coary, Dutch Guiana, Hyavary, Iça, José Fernandez, Jutahy, Lago Alexo,

Lake Hyanuary, Lake Saraca, Manacapouru, Manaos, Obydos, Rio Puty, San Paolo, Serpa, Tabatinga, Teffé, Tonantins, Villa Bella.

Anostomus dissimilis, sp. n.

D. 12; A. 11; V. 9; L.l. 43–45; L. tr. $\frac{4}{4\,(5)}$.

Nearly related to both of the preceding. Darker in color than *A. fasciatus*, and distinguished from it, as from *A. vittatus*, by the absence of a spot on the base of the tail. The blotches on the flanks vary greatly, being reduced, irregular, faint, or entirely absent. Length of head equal to the depth of body and contained in total length, without caudal, four and two-thirds times. The mouth opens forward, the lower jaw is very little the longer, the teeth are all crenulated. Twelve specimens from the Rio Puty.

Anostomus isognathus Kn.; Gth.

A. Knerii St.

The lateral band, figured by Kner, appears to be quite variable. Specimens from the Velhas show it still further reduced than in the form figured as *A. Knerii*, it being simply a black spot at the base of the caudal with faint indications of continuation forward and backward. There are five entire series between the lateral line and the ventral, or seven between the line and the median ventral series. Mouth directed forward, jaws nearly equal, teeth crenulate in the upper and lower. Snout about one and one-half times as long as the eye. Depth three and two-thirds and length of head four and one-fourth times in the total length, without caudal. The row of scales from the first ray of the ventral toward the hinder part of the dorsal passes entirely behind the latter.

Anostomus platæ, sp. n.

D. 12; A. 11; V. 9; L.l. 45; L. tr. $\frac{6}{4(5)}$.

Mouth opening forward, lower jaw a little longer, teeth crenulate in both jaws. Length of snout equal to that of the eye. Depth of body three and one-half, or length of head four and two-thirds times in the total length, without the caudal. The ninth ray of the dorsal fin is over the middle of the length. The row of scales from the first ray of the ventral toward the hinder part of the dorsal leads to the third ray from the end of the latter. There are six rows of scales between the lateral line and the dorsal and four between the line and the first ray of the ventral or five from the line to the median ventral series. This species is stouter in front of the dorsal and more decurved about the occiput than *A. isognathus;* it has larger scales and a smaller number of rows on the ventral region.

Color silvery, back darker, with lighter streak on the middle of each scale; a faint spot at base of caudal.

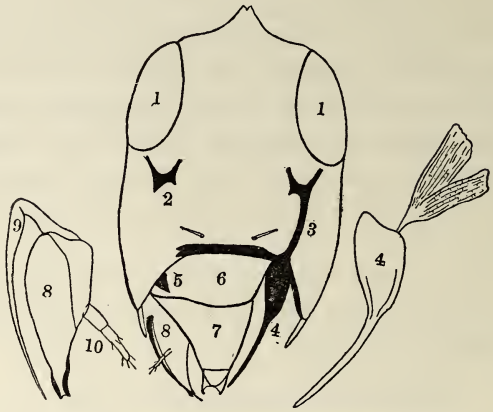
Hab. Rosario, La Plata.

Anostomus nasutus Kn.; Gth.

Mouth opening obliquely downward and forward, lower jaw shorter, teeth crenulate in upper and lower. Six series of scales between the lateral line and the dorsal, five between the line and the ventral, and seven between the line and the median row of the belly. From the darker lateral edges of the scales, the body has the appearance of being longitudinally streaked with dark. The caudal spot fades out gradually forward as in *A. isognathus.* Fifteen specimens from the Rio Puty.

THE MOUTH-PARTS OF THE THYSANOPTERA.

BY H. GARMAN.



EXPLANATION OF FIGURE.

Front (ventral) view of the head of *Limothrips cerealium* Haliday (to some extent diagrammatic). 1, compound eyes; 2, radiating part of endocranium at base of right eye; 3, bar which connects the same of left side with edge of epicranium; 4, mandible of left side, represented more enlarged at right of figure; 5, rudimentary mandible? of right side; 6, clypeus; 7, labrum; 8, galea? of maxilla; 9, lacinia? of maxilla; 10, maxillary palpus.

For some time the writer has been familiar with a peculiarity in the mouth-parts of members of this group of insects which is without a parallel among other insects known to him, and is so extraordinary that some hesitation is

felt about calling attention to it. After verifying observations again and again on several species of two genera, by dissection and other means, I am persuaded to publish a brief notice of it in the hope of getting further light, and also with a view to learning how general the peculiarity referred to is for the group, a matter which I am not able to decide from the material now in my possession.

The statements generally made with reference to the structure of the mouth are, that it is fitted for taking liquid food; that the mandibles are long, slender, styliform, and slightly swollen at the base; that the maxillæ are triangular (in outline), pointed, and bear palpi; and that the labrum and the labium are well developed, the latter with palpi.

In all the examples of the order which I have examined, the labium, with palpi of two segments, agreed closely with the published descriptions and figures.

The triangular parts (the maxillæ of authors), each with a palpus, sometimes of two, sometimes of three segments, have been easily recognized from the descriptions, but instead of being pointed they are slightly swollen at the tip, and the margins there project above one surface as chitinous rims, leaving a groove between them.

The labrum, in the species dissected, is not a symmetrical organ, but its two sides are quite different in shape.

On the right side its lateral margin is the more oblique relative to the middle line, and it extends consequently farther out on this side at its base. The lateral margin of the left side is more nearly parallel with the middle line, and the labrum does not extend so far out at the base. Otherwise the labrum agrees with published descriptions.

In every example dissected there is at the left of the labrum, and apparently articulating with the epicranium,

a well-developed chitinous organ, with a swollen base and a spine-like distal portion, which latter, when the organ is in position, passes through a sort of loop in the distal extremity of the one-sided labrum. Nothing corresponding to this conspicuous organ is apparent on the right side of the head, unless a very small chitinous structure under the edge of the clypeus is a rudiment of the organ for this side.

The asymmetry extends also to the chitinous endocranium of the head. Through the epicranium, when this has been rendered transparent, a dark bar of chitin may be seen on the left side extending from the thickened rim of the epicranium, at the outer edge of the clypeus, anteriorly nearly to the base of the compound eye of this side where it meets several converging bars, a slender one of which extends from the base of the left antenna along the inside of the eye. On the right side, the bar corresponding to that first-mentioned is not present, and the chitinous rim of the epicranium, even, appears to be here imperfect. The radiating part of the endocranium near the base of the right eye is, however, as easily made out as that on the left side, the bar alone, connecting it with the edge of the epicranium, being wanting.

What is this jaw-like organ, and why should it be developed on one side and not on the other? To the second of these questions I have no reply to make further than to suggest that it may be a case of asymmetry like that of the lungs and ovaries of serpents,—a sacrifice of one of a pair of organs for a gain in slenderness. To the first, I am compelled to reply that the organ has every appearance of being a mandible. Its form and its relations to the other mouth-parts, and to the epicranium, all indicate this. It is well supplied with muscles. It consists of a single piece.

But if this is a mandible, what are the styliform organs which have always been considered the mandibles of Thysanoptera? Two symmetrically developed organs of this kind are always present. They do not, however, consist of one chitinous segment, as commonly represented, but the styliform portion is articulated (movably, I think) at its base with a shorter piece, which by ordinary dissection comes free with the other. In dissections made with greater care these basal pieces are seen to be joined to the bases of the palpus-bearing triangular parts. It seems probable therefore that the styliform organs are lobes of the maxillæ, and that the triangular organs are also lobes of the same. The fact that the palpi are borne upon the triangular parts would indicate that these latter were the galeæ, and the more slender ones were laciniæ. But I am not satisfied with my examination of these parts, and do not wish to insist at present on more than the probability that they are lobes of the maxillæ. In position, the styliform parts lie above or below the palpus-bearing pieces, according to the side from which they are seen, and their distal portions pass between the rims at the ends of the latter. When dissected free from the other mouth-parts, and placed under a cover glass, they appear as represented in the figure, the slender pieces being pressed to the outside.

A NEW FRESH-WATER CRUSTACEAN.

BY H. GARMAN.

MANCASELLUS MACROURUS, n. sp.—Outline seen from above elongate oval, a trifle widest posteriorly. Terga convex, with an obtuse median ridge. Head excavated in front, with a slight median tooth, and a blunt prominence on each side midway between this and the lateral margin. A deep cleft in the expanded lateral portion of the head separates from the rest a posterior lobe on each side. Eyes opposite these clefts, rounded, prominent. Lateral edges of all the body segments behind the head rounded. Posterior segment very large and wide, a trifle hollowed out above the insertion of the caudal appendages. Most of the segments roughened on each side of the median ridge, all broadly explanate at the sides. Upper antennæ small, about as long as the first four articles of the second pair; composed of nine segments, the first large, globose, short; the second cylindrical, about as long as the three following together; third about twice as long as the fourth, remainder subequal. Second antennæ reaching the posterior margin of the fifth body segment when drawn back; pedicel composed of five segments, of which the first three are short, and the remaining two, long and cylindrical; flagellum swollen at base. Mandibles without palpi. First pair of legs of male with hand greatly swollen, oval, shin-

ing, white, mottled with brown. Palmar margin of hand strongly angulate near the base, the angle preceded by about five short spines. Between the angle and the dactyl is a large, sharp tooth-like projection. Dactyl with minute appressed spines on the inner edge, terminating in a small claw. First genital plates of male with the quadrate basal segment about equal in length to the greatest width of the lance-shaped distal segment. Second pair of genital plates of male with proximal segments about as wide as long; distal segment of outer ramus fringed with long hairs, obliquely truncate. Caudal appendages of adults rather large; the pedicel slightly excavate at middle of its inner margin, about two and a half times as long as wide; outer ramus about three-fourths the length of the inner ramus.

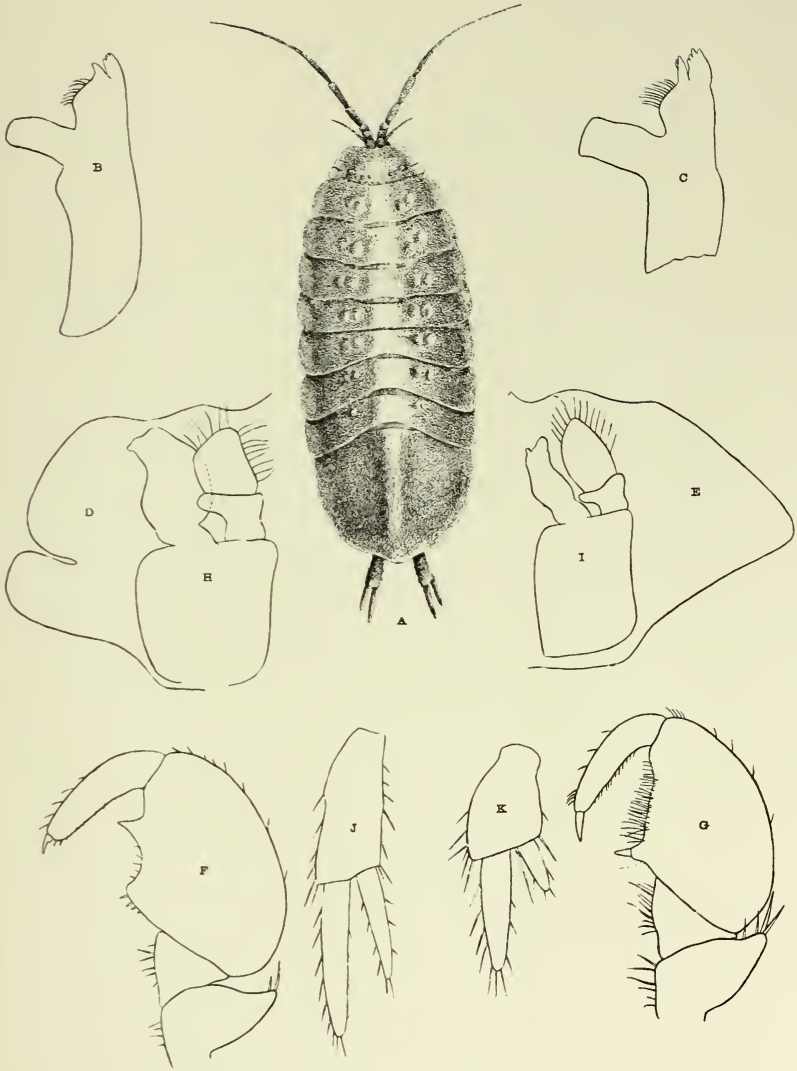
Length of adult males .63 inch; width .25 inch; lower antennæ, .38 inch. Length of adult females .44 inch.

A large and abundant crustacean in springs and spring-fed rivulets and ponds in eastern Kentucky. Large examples are of a dull gray color with the expanded lateral portions of the head and body-segments paler. In young the contrast between the central and lateral portions of segments is more decided, and two longitudinal dusky bands appear on each side, one just outside of the median ridge, and the other just within the expanded lateral portions of the segments.

The species is closely related to the Virginian *Mancasellus brachyurus*, but may be distinguished at once by the fissured lateral portion of the head, and by the greater length and different shape of the caudal appendages. Other differences equally important with these become apparent under the microscope, as will be seen by comparing the accompanying figures.

EXPLANATION OF THE FIGURES.

A. Dorsal view of *M. macrourus*, n. sp.
B. Mandible " " "
C. " " *M. brachyurus.*
D. Outline of one side of head of *M. macrourus.*
E. " " " " " " " *M. brachyurus.*
F. Hand of *M. macrourus.*
G. " " *brachyurus.*
H. One of second genital plates of male *M. macrourus.*
I. " " " " " " " *M. brachyurus.*
J. Caudal appendage of *M. macrourus.*
K. " " " *M. brachyurus.*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THE STRATIFIED ROCKS OF ESSEX COUNTY.

BY JOHN H. SEARS.

THE term "stratified rock" is applied to different rock formations in which stratification is the only common character, and although the syenites, diorite, felsites and some of the so-called breccias show stratification in part, there is little difficulty in separating them from the groups consisting chiefly of limestones, quartzites and argillaceous rocks of which this paper treats.

Nearly one-half of the bed rock of Essex County is distinctly stratified, and by means of our knowledge of these groups the geologic age of all the other rock masses may be approximated.

When we consider the frequent faulting of the rock formations and the great area which is covered by drift sand, gravel, clay and till, leaving only occasional outcrops for examination, the difficulty of preparing a correct map of the underlying rocks of the county may readily be seen.

The stratified rocks of the county which are here to be considered are divided into several groups. The principal ones are the limestones, argillites, quartzites, and shales of detrital origin, and the schists, amphibole and granitic gneisses of doubtful derivation; the whole to be classed as more or less metamorphic, a condition clearly revealed by the microscope when these rocks are studied in thin section. The effects of metamorphism on rocks are consolidation, loss of material by chemical solvents, change of

color, obliteration of fossils, and crystallization, with or without change in the constituent minerals of the rock. As examples: by metamorphism, zoisite, glaucophane, chlorite, leucoxene, epidote, etc., are formed as new minerals, while secondary formations of quartz, glassy feldspar, calcite and epidote are often seen. Brown hornblende is altered to green hornblende, augite to hornblende and magnetite, biotite to green chlorite and magnetite, besides other important changes.

Among the most interesting of the stratified rocks are the Nahant[1] limestones; they are first seen on the south side of Nahant Head at the Shag rocks and extend about three hundred yards to a point just beyond Bennett's Head on the north. The limestones are much metamorphosed into bands of light and dark lydite, microscopic sections of which reveal calcite, quartz grains, magnetite and mica, with occasional masses of nearly pure calcite interstratified with an indurated quartziferous slate. In thin sections under the microscope they are shown to be composed of calcite, epidote, quartz, serpentine, white garnets and limonite; chlorite tinges portions of the rock green, while hematite and limonite turn other parts red, thus giving the mass a brightly banded appearance, its most striking feature to casual visitors. By means of certain fossils which have been found in this rock the horizon of its formation is determined as the Olenellus, Lower Cambrian. Mr. Auguste F. Foerste first described one of these fossils (*Hyolithes inæquilateralis*, sp. nov.) in the Proc. of the Boston Society of Natural History, Vol. 24, p. 262, and I have since collected from the region numerous specimens of this species and also of *Hyolithes princeps*, *Hyolithes communis*, var. *emonsii*, *Hyolithes impar* and *Stenotheca rugosa;* all of

[1] A paper on the Geology of Nahant by A. C. Lane, will be found in the Proc. Boston Soc. Nat. Hist., Vol. XXIV, p. 91.

which have been identified by Mr. Charles D. Walcott of the United States Geological Survey, Washington, D. C.

The strike of this limestone is 18° north of east, the dip 40°–43° west.

In the month of July, 1890, I discovered an outcrop of this Olenellus limestone in a valley between Prospect Hill and Hunslow's Hill in Rowley. It has nearly all become altered to chert and epidote, but fragments of the Hyolithes fossils are still to be found in it.

This outcrop dips under a red sandstone which in turn is covered with the fine grained granitic gneiss of the region. The strike of this newly discovered outcrop corresponds very nearly with that of the Nahant rock of similar character, and is 20° north of east with a dip 45° west. A mass of diorite, known as Metcalf's rock, cuts across this limestone on the southeast near the Ipswich line and on the north it is covered by the banded red felsites of Byfield.

Near Bennett's Head, Nahant, the strike of this limestone is 20° west of north, dip 45° southeast. Here the limestone rock mass has been turned or pushed one side by the intrusion of a massive dyke of very unusual character, and which under the microscope in thin section is seen to be composed of hypersthene, olivine somewhat serpentinized, diallage, plagioclase, biotite, numerous brown zircons, magnetite, a little calcite and brown hornblende.

At a short distance north of Bennett's Head, Nahant, there is exposed at low tide a metamorphic schist having a strike northeast to southwest. It is again seen at Bass Point in the southwest part of the town. The microscopic structure of this schist in thin section is: grains of quartz, some feldspar in bands alternating with dark bands composed of grains of quartz, grains of magnetite in large amount, flakes of biotite, some flakes of chlorite, muscovite

and a large amount of grains of a slightly greenish tinge, giving, with the polariscope, quite high single refraction and often showing a rectangular prismatic outline; parallel extinction commonly giving an aggregate fibrous polarization; these grains may be andalusite decomposed to muscovite aggregates.

On the southeast side of Nahant Head, dipping under the banded limestones, is a typical argellite slate; microscopic examination shows an abundance of muscovite, numerous quartz grains with fluid and microlithic inclusions, some of the quartz grains showing the incipient cracks and partings due to crushing, well rounded grains of plagioclase probably derived from some gneissic formation, with quartz and numerous microlithic inclusions. The ground-mass is composed of earthy kaolin and fibrous chlorite and embedded in it are numerous cubical iron pyrite crystals. This slate is again seen on the north side of little Nahant where it is interstratified with a coarse mica schist containing much quartz, some of which is of clastic origin and still shows the grains of original quartz sand.

The nearest bed of metamorphic sedimentary rock is the outcrop near Flying Point, Marblehead Neck. This rock-mass is now a mica schist and is probably a metamorphosed slate; it is cut and greatly distorted by the eruptive granite. The microscopic structure of this rock-mass as shown by several thin sections that I have prepared is as follows: several grains of microcline well twinned with numerous inclusions of micro-zircons, orthoclase much kaolinized, earthy quartz in angular and rounded grains, some crushed and broken and many showing incipient cracks due no doubt to local metamorphism, much muscovite and biotite lying in the plane of the schistosity, a few grains of epidote, fragments of white garnets and numerous large patches of red garnets which are much broken and crushed,

an abundance of magnetite and some limonite. The disintegration of this rock produces the magnetite and garnet sand of the region. The mica schist of Naugus Head, Marblehead, and Woodbury's Point, Beverly, probably belong to this metamorphic slate although the metamorphism is more complete; for, in these last named outcrops, the schist is not only cut by the granite but it is also cut by the diorite, elæolite zircon syenite, felsite and diabase dykes, thus making the metamorphism of the rock-mass most intricate; indeed, as pointed out by Dr. M. E. Wadsworth, the elæolite zircon syenite has been injected in large sheets into these schists, in the planes of the schistosity and jointings of this rock, to such an extent that in some places it is puzzling to decide which is syenite and which is mica schist.

Microscopical examination shows this schist to be composed of a few grains of clastic quartz sand, much secondary quartz, secondary glassy feldspars, some muscovite, an abundance of biotite which is probably secondary, a few grains of epidote, apatite as inclusions in the ground-mass which is feebly polarizing earthy kaolin, much magnetite, red garnets and micro-zircons.

In Middleton, half a mile southeast of the village, near the house of Mr. J. U. Parker, is a well preserved clastic shale approaching a sandstone. This outcrop shows a strike nearly northeast to southwest with the dip 50° north of west; it is again seen in an outcrop in the rear or west side of the barn of Mr. Francis Peabody near the Ipswich river on the north side of the village. The microscopic structure of this shale is: angular and rounded grains of quartz which show embryonic cracks and much crushing and in some grains a secondary enlargement, plagioclase twinned feldspars broken and crushed, some of which are in well-rounded grains; ground-mass an earthy kaolin with plates of bi-

otite, some muscovite and an abundance of magnetite in the planes of the schistosity of the shale, fine inclusions of micro-zircons are seen in the kaolinized feldspars. Some of the dark opaque patches resemble lignite and it is not impossible that this shale is carboniferous, although it requires more field work and lithological study to prove it.

In the line of the strike to the northeast, across the Ipswich river in Topsfield, on the land of Mr. Peterson, two hundred yards northwest of the old Endicott copper mine, this shale, which is here a dull red color, protrudes in several places. It is interstratified with a ferruginous sandstone ; the strike remains constant, northeast to southwest with the dip 50° west. The microscopic structure of thin sections from the outcrop near the roadside is as follows : section cut across the bedding, ground-mass of earthy kaolin much discolored with a ferruginous iron oxide, magnetic titanic iron, some leucoxene, original quartz grains showing secondary enlargements, incipient cracks and broken grains and also fluid inclusions, some feldspars much decomposed, muscovite scales, green chlorite, apatite, numerous microliths and zircons, a few grains of zoisite and epidote. A strongly developed shearing to the north accounts for the crushed and broken appearance of the quartz and feldspar grains. Section across the bedding from a specimen of the outcrop in the field on the opposite side of the road, near the dwelling house of Mr. Peterson: ground-mass composed of earthy kaolin and fibrous chlorite, magnetite, titaniferous iron surrounded by leucoxene, micro-zircons, apatite, numerous microliths so small that they cannot be determined with the highest power of the miscroscope, quartz grains with numerous fluid inclusions, muscovite and a few grains of zoisite are arranged parallel to the bedding. Ferruginous sandstone from Peterson's land, Topsfield (Sec. 81) : ground-mass of

quartz and feldspar grains, numerous flakes of muscovite with detrital angular fragments and pebbles of the quartz, feldspars colored with ferreous oxide, some epidote and chlorite and threads of calcite.

Continuing on the strike of this shale, there are two outcrops in the northeastern part of Topsfield, one in Linebrook, a parish of Ipswich on Bull Brook, one in Rowley near John Dodge's mill and another near tide water between Ipswich Village and Rowley. The microscopic structure of the sections from specimens in the cabinet of the Peabody Academy of Science from these localities is nearly the same as that of the last two from Topsfield. Other outcrops of these clastic shales are frequent in the northern part of the county. There is on the south bank of the Merrimac near the Artichoke river, a large area of this shale much crumpled and distorted with the strike north and south and dip vertical. Near the point where Indian river empties into the Merrimac the shales are continuous for three hundred yards, and from Bradford across North Andover and South Lawrence, in a southwest course, they can be traced in an almost unbroken line to West Andover. On this strike the shales are bedded between the granite gneisses on the south and the metamorphic slates on the north.

At North Saugus, near the corner of Main and Oak streets, is an outcrop of metamorphic slate interstratified with a quartzite, and on Main street two hundred yards east of the school house the hornblendic eruptive granite cuts directly across this metamorphic slate and includes large fragments of it. The strike of these metamorphic slates and quartzites is north 20° E. parallel to that of similar beds at Lynnfield Centre. The microscopic structure of this metamorphic slate is : clastic quartz grains with many fluid inclusions, well-rounded grains of plagioclase, orthoclase

almost entirely decomposed, biotite, some muscovite, and magnetite, ground-mass, a ferruginous earthy kaolin with some fibrous chlorite and a few grains of epidote.

The quartzite from the same place in thin section shows: quartz grains with numerous fluid inclusions, feldspars much kaolinized and containing numerous inclusions of apatite, tourmaline and epidote, while patches of chlorite are often seen in the line of the bedding; the whole rock mass is thoroughly saturated with a ferruginous limonite giving it a dirty yellowish color. The microscopic structure of the quartzite from Lynnfield Centre is: quartz grains containing numerous fluid inclusions and incipient cracks, also crushed and broken grains produced by pressure in the rock-mass during metamorphism, much secondary quartz which, with the polariscope, gives the usual wavy extinctions, some grains of secondary glassy plagioclase, perfectly fresh grains of microcline, orthoclase kaolinized and much decomposed, with numerous inclusions of zircons and apatite crystals, some chlorite and a little biotite. This outcrop is exposed for a distance of one hundred yards and is in some places finely schistose and laminated, while in others it is massive; the strike is north 20° east, dip 50° west.

Nearly all of the bed rock of West Newbury, Groveland, Haverhill, Bradford, Lawrence and Methuen is composed of metamorphic slate. The microscopic structure of a specimen of this rock from Ward's Hill, Bradford, section cut across the bedding, is largely of detrital grains and angular fragments of quartz, many of which are crushed and broken, orthoclase grains nearly all kaolinized and earthy, biotite mica abundant in the planes of the schistosity, some original muscovite, microscopic zircons, rutile and titanic iron. A section parallel to the bedding shows large masses of chlorite developed as a product of decomposition of the biotite and inclusions of apatite crystals are abundant.

The microscopic structure as shown by five sections of this metamorphic slate from East Haverhill is: angular and rounded grains of quartz in some of which there are numerous fluid inclusions, several quartz grains in the line of the schistosity of the rock-mass showing cracks from all the incipient stages to the broken and crushed masses, feldspar grains much kaolinized and showing the effect of crushing, some of the grains being broken into several pieces, scales of muscovite and biotite arranged in layers parallel to the schistosity of the rock-mass and inclusions of apatite, zircons, fibriolite and rutile abundant in the kaolinized feldspars. Titaniferous magnetite and leucoxene are scattered through the sections and fine acute rhombs and long lath-shaped sections of titanite are seen in one of the thin sections.

The microscopic structure of the metamorphic slate in the bed of the Merrimac river below the Lawrence dam is: clastic grains of quartz sand, some secondary quartz surrounded with earthy yellowish kaolin and chlorite masses, titaniferous magnetite and leucoxene and a few grains of plagioclase with inclusions of apatite, zircons and fibrolite.

The quartz grains show evidence of crushing, embryonic cracks are developed and some of the grains are broken and the pieces faulted two and in one instance three times.

Nearly all of the bed rock of Methuen is composed of this metamorphic slate and a coarse mica schist of the same composition as that from Lawrence, Haverhill and Gage's Hill in Bradford. In Methuen this slate and schist is over one thousand feet in thickness; the trend is north 40° east southwest, dip 45° west. Nearly every outcrop from West Andover across Lawrence, Methuen, Bradford, Haverhill, Merrimac, South Hampton, Hampton Falls and North Hampton to Rye in this strike is composed of these same metamorphic slates and schists.

On Kent's Island in Newbury, at the junction of Little and Parker rivers, there is a bed of argillite interstratified with sandstone which extends about one thousand yards on the bank of the Parker river to a point near the Eastern Railroad and on Little river one hundred yards west. Some of the beds are of a dull red color resembling the North Attleboro and North Weymouth slates while others are of a greenish color. They are cut in several directions and are distorted by felsites and amygdaloidal melaphyrs, shearing and faulting to such an extent that the true bedding is quite difficult to determine. By uncovering the glaciated surface, however, and washing away the clay and drift the bedding is plainly revealed. The strike is 50° north of east, dip 55° southwest. The microscopic structure of a very opaque section of the red slate, cut across the bedding is: clastic quartz grains and fragments showing secondary enlargement and crushing and containing numerous fluid inclusions, surrounded by a ground-mass of earthy kaolin, much muscovite and ferruginous magnetite and limonite. The sections of the green slate from Little river are composed of angular and rounded quartz grains, a finely fibrous kaolinized ground-mass, some epidote, muscovite, a few grains of zoisite and much chlorite. The alternating sandstone is composed of quartz and feldspar grains, some biotite and scales of muscovite and much ferretic oxide.

In Andover, near Butterfield's saw mill, is an outcrop of metamorphic micaceous sandstone lying parallel to the hornblende schist on the east; this formation is again found at John Jenkins' farm near the cross road to Ballard Vale. The microscopic structure of sections from these outcrops is: quartz grains of original sand cemented by a film of ferreous oxide and some secondary quartz, scales of muscovite and biotite and masses of fibriolite. One of the sections

from the last-named outcrop is composed of quartz grains and angular fragments with numerous fluid inclusions showing incipient cracks and broken grains, much muscovite, some biotite, magnetite, chlorite and epidote.

Another large area of the metamorphic slate, interstratified with sandstone, first seen near a small pond in South Groveland, is nearly continuous from Johnson's pond in West Boxford to the north side of Chadwick's pond in Bradford and forms all the adjoining outcrops for nearly two miles in North Andover. The microscopic structure shown by several sections is :well rounded original grains of quartz and plagioclase, biotite, muscovite, a little chlorite cemented by a thin film of secondary quartz and ferreous oxide. One of the sections contains magnetite and limonite. The sandstone is composed of nearly pure quartz sand cemented by some secondary quartz and a fibrous feebly polarizing felspathic mass ; fluid inclusions in which the bubble movement is quite active are frequent in the quartz grains. In a cutting of the Boston and Maine Railroad just north of Reading, Middlesex county, is a fine exposure of hornblendic gneiss showing great variety. Succeeding this on the west are sandstones, diorites, coarse granitic gneisses and eruptive granite dykes ; on the east are the eruptive hornblendic granites and crystalline gneisses of Middleton. The strike of the whole series is north 40° east, dip varying from 30° north of west to 90°.

Following the strike of the hornblendic gneisses into Essex county there are outcrops in various places near Foster's pond, Andover, and on the roadside, in a cutting near the John Jenkins farm, there is an exceptionally good exposure where this gneiss is seen for several rods with the same strike with the dip slightly to the west. Continuing, numerous exposures are seen in Farnamville, North Andover, at Marble Ridge near the railway station, on both sides

of Andover great pond, across West Boxford to Chadwick's pond and throughout the entire region between Chadwick's and Stiles' pond. Here observation is interrupted by numerous drift hills; but, beyond, on the same strike we find numerous outcrops in Georgetown, on both sides of Gravelly pond, and in Byfield and the Newbury mining region where there are several good exposures; also on the Smith mining lands in Newbury where it forms all the bed rock exposed; it is last seen at Black Rocks, East Salisbury. In some places this gneiss is but a few rods wide while in others it enlarges to nearly a mile in width.

There are also several areas of this rock to the north and south of this line of strike. One in North Andover near Mr. Lacy's farm on the road to East Boxford covers several acres, lying between the metamorphic slate on the north and a crystalline gneiss at the south. This formation extends into East Boxford and forms the famous Crooked pond outcrop which is nearly half a mile wide and can be traced by lesser outcrops to Chaplinville, Rowley, a distance of six miles.

Twenty microscopic sections of the metamorphic hornblende epidote gneiss taken from every outcrop in the strike from North Reading to Black Rock, Salisbury Beach, give the structure as follows: section across the bedding of specimen from the John Jenkins farm, Andover; brown hornblende allied to green hornblende, magnetite, plagioclase with numerous inclusions of quartz, biotite flakes and masses in the plane of bedding, numerous quartz grains, many of them well rounded and containing numerous fluid inclusions, some patches of chlorite, numerous grains of epidote, a little sahalite and large masses of zoisite.

Section across the bedding of specimen from east of the Lacy farm, North Andover: green hornblende with epidote inclusions, much biotite, quartz grains and patches of

secondary quartz, some plagioclase deeply kaolinized, ground-mass of kaolinite, epidote and magnetite and some zoisite in the plane of the bedding. Specimen (fibrolite gneiss) collected at Marble Ridge, south of the railroad station: quartz, plagioclase and orthoclase feldspars in grains, large flakes of muscovite, biotite, and acicular crystals of fibrolite, in aggregates, scattered through all the minerals; the plagioclase has numerous inclusions of quartz and the biotite inclusions of zircons and garnets which show fine pleochroic halos. In the ground-mass are patches that strongly resemble corderite, but so much altered that determination is difficult. In hand specimens this rock is nearly identical to the genuine corderite gneiss.

Hornblende epidote gneiss from Crooked pond, East Boxford; section across the bedding, microscopic structure: green hornblende, twinned feldspar with numerous inclusions of quartz grains, patches of quartz in which there are numerous fluid inclusions, large patches of zoisite, biotite and magnetite, numerous areas of chlorite and some epidote. Section parallel to the bedding shows the zoisite surrounding hornblende crystals and the hornblende in turn surrounding grains of magnetite, all lying in one plane across the section dependent upon one plane of pressure. Titanic iron surrounded with leucoxene is abundant in this section. Specimen from east of Chadwick's pond: quartz grains, apparently detrital, with numerous fluid inclusions, much biotite, some plagioclase with inclusions of quartz, some chlorite and magnetite. This may be termed a biotite schist. Metamorphic hornblende epidote gneiss from Smith Mine, Newbury. Microscopic structure of section across the bedding: green hornblende with numerous inclusions of plagioclase and magnetite, much biotite, some muscovite, grains of quartz showing enlargement by the addition of secondary quartz, orthoclase much decom-

posed, in which there are numerous inclusions of apatite, epidote and micro-zircon crystals. The ground-mass is a feebly polarizing earthy kaolinite in which there are cubes of iron pyrite, masses of chalcopyrite and a little galenite, some zoisite masses are developed in the line of the schistosity of the rock-mass and some of the magnetite is titanic iron around which patches of leucoxene have developed. Judging from the majority of the sections studied it is probable that this gneiss is derived from an igneous rock rather than from detrital material, although some of the sections indicate the latter origin. During the mining excitement of 1875 and 1876, a boring was made through this gneiss striking limestone at a depth of fifteen hundred feet. Microscopic sections of specimens from Black Rock, East Salisbury, at the mouth of the Merrimac river, show detrital quartz grains and angular fragments, plagioclase much decomposed, numerous plates of biotite arranged parallel to the bedding, some green hornblende, epidote grains, titanic iron and leucoxene. The ground-mass is principally secondary quartz and ferrite, cementing an earthy fibrous kaolinite. With the polariscope the secondary quartz gives the usual wavy extinctions.

To the south and running parallel to this hornblende epidote gneiss is a band of thoroughly crystalline metamorphic gneiss. The finest outcrops are to be found at Middleton, Boxford, Georgetown, Byfield and the Newbury mining region. The microscopic structure of sections of specimen from Middleton (No. 18) is : quartz grains and patches, plagioclase with numerous inclusions of quartz, biotite and epidote, green hornblende with inclusions of biotite and apatite crystals, some titanite and chlorite ; ground-mass of secondary quartz and ferrite. Microscopic structure of sections from Boxford (Nos. 109, 110) : numerous quartz grains, well rounded plagioclase grains, much ortho-

clase deeply kaolinized; both the plagioclase and the orthoclase having numerous inclusions of quartz and biotite. There are also grains of epidote and fine dust-like ferrite, and muscovite plates arranged parallel to the bedding. Microscopic structure of section of specimen (No. 111) from John Noyes' Copper Mine, Newbury, closely resembles the sections from Boxford (Nos. 109, 110) excepting that there is more biotite, that numerous cubes of iron pyrite are scattered through the dust-like ferrite and that microliths are of numerous occurrence.

In the northern part of the county, occupying nearly the whole of the region known as Ballard Vale, West Andover, South Lawrence, a part of North Andover, Bradford, Haverhill at Ayer Village, and passing into New Hampshire, is a coarse granitoid gneiss cut by dykes of eruptive hornblendic granite and diorite. In Andover and North Andover the strike of this gneiss is east 40° north, parallel to the metamorphic slate, dip 35° southwest. A large area of this gneiss in West Andover and South Lawrence has been opened for quarrying purposes and fine exposures may be seen in a quarry at South Lawrence worked by Mr. Jesse Moulton. The strike at this point is east 20° north, dip 85° south of west. The microscopic structure of sections of this rock is: coarse masses of orthoclase, microcline, quartz, muscovite, garnets cemented together by a thin film of secondary quartz. Numerous inclusions of quartz, biotite and muscovite are seen in the feldspars. I have traced this gneiss by means of numerous outcrops through South Hampton, Hampton and Rye to the Isles of Shoals. At Rye an old quarry offers good facilities for study, and specimens received from Appledore Island are of the same character and show the same microscopic structure in thin section.

At Folly Point, Lanesville, and also at West Glouces-

ter, near the Loaf on Coffin's Beach, occurs a hornblendic biotite gneiss. The microscopic structure (specimens Nos. 88 and 122) : is hornblende with numerous inclusions of biotite and quartz, plagioclase grains with inclusions of quartz and apatite, magnetite, some patches of limonite, epidote, chlorite, and titanite and rutile inclusions in the ground-mass which is a fibrous earthy kaolinite.

In an economic aspect these stratified rocks possess special interest, for it is in the rocks of this class in the county that the ores of silver, lead, copper, etc., are found as shown by the results of the mining operations in the vicinity of Newbury, Georgetown and Boxford.

The transitional forms of these metamorphic schists and gneisses have not been fully studied in the field, but their occurrence in connection with the metamorphic slates and sandstones indicates that they are transitional forms of these rocks, the metamorphism being in part due to the great pressure and crushing caused by the granite and diorite masses which have been erupted through them. And, furthermore, zoisite, so far as observed, is only found in metamorphic sandstones and gneisses, except as an epigenitic constituent of eruptive rocks (Becker, Geology of the Pacific Slope, United States Geological Survey, Monog. XIII, p. 82), and zoisite is of frequent occurrence in the hornblende epidote gneiss of Essex county.

June 3, 1890.

NOTE.—On the fishing ground known as Jeffrey's Ledge, twenty miles east-northeast from Thatcher's island, at the depth of forty-five to fifty fathoms, the fishermen often pull up on their anchors and trawl lines, large masses of the Olenellus lower Cambrian chert and limestone, identical in composition with that at Nahant Head and Rowley. Jeffrey's Ledge is about forty-five miles northeast

from the Nahant locality, and east-southeast from the Rowley outcrop. I have observed for several years pieces of this rock, in a more or less decomposed state, in places in Rockport and Gloucester frequented by fishermen, but could not obtain satisfactory information as to their source; therefore, definitely locating this rock at Jeffrey's Ledge is of importance as proving the extent of the lower Cambrian deposit on the coast of Essex County, Mass. I have recently procured a fine specimen of this chert and limestone which was hauled up on a trawl line by Mr. George Parsons of Rockport; he states that the fishermen call it "horse sponge" and, as it is often perforated by numerous worm borings and covered with hydroids and algæ, it certainly resembles a calcareous sponge.

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ON A GENUS AND SPECIES OF THE CHARACINES (*Henochilus Wheatlandii*, gen. n. et sp. n.).

PLATE I.

BY S. GARMAN.

Characters.—Body oblong, compressed, covered with large scales; belly rounded; head naked. Intermaxillaries and maxillaries forming the margin of the upper jaw. A lip on the lower jaw, none on the upper. Mouth wide; teeth in each jaw strong, compressed, trenchant. Gills four, openings wide, membranes free from the isthmus and separated from each other; gill-rakers setiform; no pseudobranchiæ. Nasal openings close together. Dorsal fin placed nearly in the middle of the body, near a vertical from the ventrals; anal long; caudal deeply notched. Lateral line continuous.

DESCRIPTION.

Br. 4–5; D. 11; A. 26; V. 8; P. 14; C. $\frac{13}{11}$; L. l. 47; L. tr. $\frac{8}{4-5}$. In shape this fish resembles the common carp, or some of the stouter forms of the species of Cor-

egonus; the body is deep and moderately thick, strongly arched behind the head and rounded on the belly. The head is rather small, about one-sixth of the total length, including the caudal fin, or a little more than half of the depth; it is quite naked and approaches the subconical in its outlines, but is blunt and rounded on the snout; across the interorbital space it is strongly arched. Snout broad, nearly twice as long as the orbit, rounded. Nostrils close together, separated by a valvular fold of the skin; posterior larger, subtriangular; anterior much smaller, circular, nearer to the eye than to the end of the snout. The orbit measures about one-fifth of the length of the head, or two-fifths of the interorbital space. Mouth wide, extending almost as far back as the middle of the eye, without an upper lip, with a well developed lower lip.

Teeth broad, compressed to a sharp edge, which is rounded on the summit. At each side of the rounded or spatulate cutting portion of each tooth, near its base, there are two small denticles or cusps, the upper of which is the sharper. As the teeth are imbricated in the series, in such a way that the outer (hinder) edge of each lies outside of the next following, only the posterior pair of the denticles of a tooth are visible from without, the anterior pair being hidden by the tooth immediately preceding in the row. On mandibles, intermaxillaries and maxillaries the teeth are alike. Those on the latter occupy more than the half of its length and extend almost to a vertical from the middle of the eye; they with those of the intermaxillary form a continuous and regular series. On the intermaxillary close behind the middle, there is a short series of three (four) smaller teeth of similar shape. The maxillary is firmly connected with the intermaxillary and at the hinder end of the dental series becomes narrower and bends downward abruptly. At the symphysis behind the

mandibular series there are two small teeth with sharp cusps that curve backward toward the throat. A lip covers the lower teeth, but the upper are quite exposed. There are no teeth on the roof of the mouth. The pharyngeal teeth are very small and form small granular pavements. On one side there are four branchial rays; on the other side there are five. The gill-rakers are short and slender, setiform. Of the three bones behind the orbit the lower is the largest, about as large as the eye, and the middle one is the smallest.

The pectoral fins are but moderate in size, as long as the head; they reach a little more than half way to the ventrals, and they have fourteen rays. The dorsal fin is behind the middle of the body, behind the base of the ventrals, and has eleven rays, the second and third of which are prolonged into a point. The adipose fin is near the caudal, over the posterior extremity of the base of the anal. Anal elongate with twenty-six rays, of which the third to the fifth are elongate. Ventrals short, reaching the vent, in front of the dorsal, with eight rays. Caudal deeply notched, more than half of its length, with lobes nearly equal, the upper having thirteen rays and the lower but eleven.

Scales very large and thin, with membranaceous edges. The exposed portion of each scale is broad and short; it is silvered in its posterior half. In the lateral line there are forty-seven scales, in a series from it to the dorsal there are eight, and between it and the ventral there are four on one side of the body, or five on the other.

That portion of the air bladder lying immediately behind the skull is firmer and more rigid in its walls; its length is about one and three-fourths inches. The connection between the two parts is a narrow rather solid mass of tissue of about half an inch in length. The hinder section of the

air bladder is about five inches long by seven-eighths of an inch in greatest diameter, gradually tapering behind the middle; its walls are much thinner and not at all rigid.

The stomach is filled with parts of various plants, for the most part of some broad-leaved succulent cabbage-like aquatic plant. In cropping such thick leaves an upper lip would only be an obstacle. As the upper teeth are flush with the outline of the face and include both lower teeth and lip when the mouth is closed, the arrangement is admirably suited to the habits of the fish.

Total length sixteen and one-fourth, head two and three fourths, and depth four and seven-eighths inches.

Color nearly uniform, slightly brownish on the back, lighter beneath, silvery.

Hab.—Santa Clara, on the Rio Mucury, Brazil, where it was secured for the Museum of Comparative Zoology by Messrs. Hartt and Copeland of the Thayer Expedition.

The position of this genus in the system is close to the genera *Tetragonopterus* and *Scissor*. The species is named in honor of Dr. Henry Wheatland, President of the Institute, in token of appreciation of his friendly interest and sympathy in favor of ichthyology and ichthyologists.

Henochilus Wheatlandi.

ON BALISTES VETULA Linné.

BY S. GARMAN.

A HANDSOME specimen of this fish was taken at Wood's Holl, Mass., about the first of October and forwarded to Prof. Alex. Agassiz by Messrs. Geo. B. Appleton & Co. of Boston, the well-known dealers in fishing tackle. It is seldom this species of "trigger fish" is taken so far north, though it is common enough around Florida and the West Indies. The total length of the example in hand was nineteen inches, or fourteen excluding the caudal fin. The greatest height was nine and one-fifth inches, or without the dorsal fin seven and a half. In thickness at the middle of the body it was a little more than two and a half inches. It was evidently in very good condition, its great distance from its proper home notwithstanding. The formula for fins and scales stands thus:

D. 3 + 31; A. 29; V. 22; P. 16; C. $\frac{6}{8}$; L.l. 64.

The filamentary prolongations of the anterior rays of the second dorsal and of the upper and of the lower rays of the caudal are only moderately long, those of the caudal, however, being longer than the fin itself.

The colors on this fish are darker than on others from St. Thomas. The scales are not so dark as the skin between them. On the back and on the top of the head the brown is very dark, as, also, on the fins; it grows lighter on the flanks, to light below the chest and throat. The blue markings are vivid but not as numerous as on younger

specimens. They include the following: a narrow ring around the snout; a streak behind this, from its upper portion, along each side of the face, toward the ventral spine, stopping at the level of the lower edge of the pectoral; another stripe parallel with the last passing from the base of the pectoral over the forehead; a narrow streak from the lower edge of the eyeball across the forehead, and faint indications of one or more of the radiating orbital bands above this; a band along the bases of the fin rays of each of the fins; a wide band around the caudal pedicel, between which band and that at the bases of the caudal rays there is a single very narrow streak; and near each margin of each of the fins, but separated from it by a narrow edging of brown, there is a narrow band of the blue, that on the concave portion of the caudal fin being widest. Compared with Bloch's figure (of a smaller specimen) it lacks the narrow streaks on the central portions of the fins, has but two bands around the caudal pedicel, instead of four or more, and the lower band of the face does not extend back to unite with that touching the base of the pectoral, the latter band being continued farther down and also extended up behind the shoulder. Only two of the lines radiating from the eye are to be seen. The faint oblique lines seen on the back of the figure are entirely obsolete. The mentioned figure gives a very misleading idea of the teeth and of the ventral fins. There are in the specimen but eight somewhat compressed or incisor-like teeth obliquely extended forward in each jaw; the anterior pair are more pointed, and the others are notched so as to appear rather indistinctly bicuspid. The ventrals are peculiar; in that they appear as a single fin. On dissecting them out it is found that they really are separate fins which from opposite sides of the body are brought down and applied to each other on the median ventral line, so

that the outer extremities of the rays form a single series, those of one fin alternating with those of the other, while their bases are kept apart by the posterior prolongation of the coxa. The rays are all simple; the spine probably represents two rays, one from each fin. In the embryo no doubt at some stages the two ventrals will be found entirely distinct, and in tracing the affinities of the species backward we may expect them to lead to forms on which throughout their lives these fins remain separate.

SILURUS (PARASILURUS) ARISTOTELIS.

Glanis Aristotelis Ag., 1856, Pr. Amer. Acad., 333 (named).

BY S. GARMAN.

B. 13 (12–14); D. 3; A. 72 (67–76); C. 18; V. 9 (9–10); P. 1 + 11 (11–12).

In shape this species bears much resemblance to the *Silurus glanis* of Linné. Its body is elongate, depressed anteriorly, strongly compressed from the vent backward, the greatest depth in an eight-inch specimen being about one-fifth of the length without the caudal fin, and that portion of the length behind the vent being rather more than seven-elevenths of the total length. The head is broad, depressed, slightly arched across the crown, little less than one-fifth of the entire length, a trifle more than one and one-third times as long as wide, and is broad and rounded on the snout. Seen from above, the lower jaw appears to be the longer by the width of the band of teeth. There are but four slender threadlike barbels, of which the maxillary do not quite reach the end of the pectoral, not being one and one-half times as long as the head, while the mandibulary are less than half as long as the maxillary. The eye is so small that its diameter is contained more than four times in the interorbital space, more than twice in the length of the snout, more than eight times in the length of the head, and is nearly equal to the distance from the base of the barbel. It is situated above and close to the

angle of the mouth. A broad interspace, more than half the diameter of the eye, interrupts the narrow band of vomerine teeth in the middle; they might be described as two short transverse bands, the length of each of which is a little more than twice its width. In the first series the gill-rakers are short, sharp, rigid, not as long as the eye, and vary in number from twelve to fifteen. The dorsal fin is very slender, having only three rays, and is situated at about two-sevenths of the distance from the snout to the end of the tail, or a little in front of the hinder extremities of the pectoral spines if they are applied to the sides. There is no adipose fin. The anal fin is long, nearly four-sevenths of the length, without the caudal, and contains, in most cases, more than seventy rays. One of the individuals in hand has only sixty-seven. At the end the caudal fin is rounded or subtruncate; generally it has eighteen rays, rarely there are nineteen; it is united with the anal less than half its length. The ventrals are farther back than the dorsal; on four specimens there are nine rays in each ventral fin, on two others there are ten rays in each, and one has ten rays in one ventral and but nine in the other. In length the pectoral fins equal the distance from the eye to the end of the opercle; they are broadly rounded on the posterior margin, and most often contain one spine and eleven rays; rarely the number of rays is twelve. The spine is strongly compressed; the teeth on its hinder edge are sharp pointed and comparatively large, those in front are distinct but smaller.

The coloration of the back and of the top of the head is brownish, of the sides silvery with rather coarse brown puncticulations arranged in irregular nebulous groups which approximate to blotches along the base of the anal and on the anterior half of the caudal.

The description is taken from specimens in the Museum

of Comparative Zoology, collected by Dr. Roeser in the Acheloüs (Aspro) river in Acarnania, Greece. The largest is less than nine inches in length. From the young of *S. glanis* L., of equal length, they are readily distinguished by the possession of four barbels instead of six, by the difference in shape of those on the maxillaries — they being shorter, less compressed and more threadlike, by the wide separation in the middle of the band of vomerine teeth, by a larger eye, by a greater slope to the sides of the head, by a smaller dorsal, by the smaller number of rays in the anal, and by the markings.

Young individuals of *S. glanis*, from the Danube, have broader flatter heads, shorter lower jaws, smaller eyes, longer flatter maxillary barbels, smaller pectoral spines — without denticulations in front and with very small ones behind, blacker ventrals and pectorals, and flanks marbled with brown and white, the latter in irregular spots of varying depth but distinct definition. The eyes have less of a lateral outlook than in the Grecian species.

Apparently the new species is a near approach to that described as *S. chantrei*, by Sauvage, from the Koura (Kur) river, at Tiflis, a stream flowing into the Caspian. The characters given that species are "D. 3; A. 65; P. 1 + 13; V. 10." "Allié au *S. afghana*, Günther, en diffère par l'épine pectorale non dentelée, la bande vomèrienne subinterrompue au milieu, les barbillons plus longs." Günther's type had maxillary barbels twice as long as the head, vomerine teeth in a very narrow, uninterrupted curved band, a pectoral spine without denticulations, a dorsal with two rays and an anal with seventy.

The specimens above described are undoubtedly those of which Prof. L. Agassiz speaks in his communication to the American Academy of Arts and Sciences, Nov. 12, 1856, published in volume III of its Proceedings, p. 325.

On page 333, he gives the name *Glanis Aristotelis*, without a description. To complete the history of this fish we should have to include the references of Aelian, Athenaeus, Pliny and subsequent writers who have depended on the great Grecian author for their information. Though the species is allied to the *Silurus glanis* of Linné, it falls into a different division of the genus on account of the smaller number of barbels. It pertains to the group to which Bleeker gave the name *Parasilurus*, the members of which have but four barbels. The distribution of *Parasilurus* is thus shown to extend from the Adriatic across the entire southern part of Asia, and from the Caspian southward.

ON THE "GILA MONSTER" (*Heloderma suspectum*).

BY S. GARMAN.

LATE in May, 1889, through the kindness of Miss Mary Woodman, the Museum of Comparative Zoology at Cambridge, Mass., came into possession of an unusually handsome specimen of the "Gila monster," one of the largest of the lizards and the only one reputed venomous. He had been secured at Casa Grande, Arizona, by Mr. Daniel H. Bacon and forwarded in such a manner as to reach us little the worse for the handling and the change of climate. His arrival in good health and in the warm season gave opportunity for taking a number of notes that may add something to what is already known concerning the species. For more than a year he was kept alive and under observation. Animals that have been brought any distance usually arrive very thirsty, and the first move toward domesticating them is made in giving them water. Heloderma was no exception. In an arid dwelling place such as his, four or five days, the length of the journey, would not be expected to prove a very long time between drinks, but he drank as if nearly famished. A stupid and impassive appearance did not prevent such manifestation of intense enjoyment as made it a pleasure to watch the slow process of satisfying what, for the time, was the greatest desire of the creature's existence. More than half an hour elapsed from the time the snout was brought down to the liquid and the tongue thrust into it until the

head was raised and, licking the lips and yawning to disclose the inky blackness inside the mouth, preparations were begun on a sleeping place. Shortly afterward an egg was broken into a dish and placed within reach; it was taken with evident relish, in the same manner as the water; the chin was dipped into it and the tongue thrust out, bent downward and drawn back again. The tongue is thick and riband-shaped, *i. e.*, long, narrow and somewhat depressed. In protrusion it first makes its appearance as a single sharp point; as it comes farther out the tip separates into two points, and the organ is seen to be forked for a short distance. When fully protruded, the aspect is changed and the outline of the extremity, as seen from above, resembles that of the tail of a shad. As the tongue is drawn in, the tips approach each other till once more closely applied. Thus, the forked portion moves sidewise like the blades of a pair of scissors as the tongue goes out and back. Any of the fluid that adhered was carried into the mouth by the retraction, and no doubt the tongue was followed by a slight current induced by suction that took in a little more; the amount of suction, however, must have been very slight, judging from the time occupied in eating a single egg. On each of four days one egg was consumed; then followed a week of fasting, the most of which was cloudy weather. Readiness to feed depended greatly on the temperature and brightness of the day; in consequence the meals were quite irregular.

On the bottom of the box there were some inches of sand with several rocks; under the side of one of the latter the burrow was made. The digging was all done with the hands; beginning with the left the sand was thrown back with some force in slow strokes, about thirty to the minute, then the right was used in the same way. The motions were outward or lateral, not vertical like those of

a dog. For a while the sand was dug out directly, until it began to pour back; then a position was taken up on the top of the heap that had been made, and it was thrown still farther back; gradually working forward, conditions were soon made favorable for continuance of excavation at the bottom of the burrow. At the depth of about a foot the body was hidden and only the tail exposed. This depth appeared to be satisfactory for a time, and the dwelling was occupied as if complete.

The tail is club-shaped, near six inches in length by one and a half in diameter, and retains its thickness back toward the end where it rather abruptly tapers to become more slender and pointed. When the tail was sticking out of the excavation, as in digging, the slender extremity moved from side to side, back and forth and around, with more flexibility than was to be expected from its size, as if constantly on the alert for unseen danger. The organ is very sensitive. While asleep the tail was stowed as if to insure its safety; it was either extended directly back into the burrow, half of the body remaining outside, or, when the animal was wholly under cover, it was bent forward along the side. In sleep, the body lies flat on the sand and the arms were usually stretched back, palms upward. After a few weeks, less care was taken in regard to entering the burrow during the day, and the naps were taken anywhere in the box.

The box was not well placed for the sunshine; it was covered with a strong netting. Some attempts to get through the net one morning caused the occupant to be taken by the shoulders and lifted over into another cage where he might get the full benefit of the sun. This was quietly enjoyed until the sun had passed, then there was another attempt on the cover, followed by return to the first box and retreat into the hole. This came to be the

regular proceeding: every morning about nine o'clock the fellow climbed up in the corner of his box whence he was lifted over into the sunshine to take a nap until the shadows came upon him, then he would climb in the corner again till returned to the larger box to take his favorite position in his den for a while. To forget or neglect him was out of the question; his scratching would not permit it.

The number of eggs charged to him does not average more than one per week; the other food given him amounted to very little.

In the latter part of July he began to slough. The epiderm came off in a very ragged way, in shreds and patches. There seemed to be no effort to hasten the process and a month later it was not entirely finished. Thinking to hurry the matter, in case all had not gone along in the normal way, a bath tub was furnished with water sufficient to completely cover him. At once he showed a fondness for lying in the water with his snout sticking out; this was varied by lying on the bank with his tail sticking in, a position which he apparently found to be very delightful.

Heloderma was really good-natured. To be sure he was easily worried into self-defence, but there was nothing vicious in his disposition. To scratch him on the sides, or rub the knobbed scales of his back, or, more readily than either, to blow in his face would make him open his mouth, for which he was not much to be blamed, but even then something had to be put between his teeth to get him to bite, he had so little desire to take hold of his tormentor.

His thirst required more attention than his hunger; he drank frequently and always with great deliberation. To tempt his appetite various things, such as insects, worms, young birds, mice, meats and cooked foods were put be-

fore him. He took none of them voluntarily, but would swallow occasional offerings if they were put into his mouth. Some things he would not accept on any terms, they were put out of the mouth as fast as put in; others that he might be induced to swallow were held in his jaws for a long time. At the end of a year the only evidence of loss of flesh was to be noticed near the end of the tail, where it had grown a little more thin and pointed. The body had retained its plumpness, being rather more than three and a half inches wide to twelve inches long, without the tail.

His only sound was a long-drawn aspirate hah, like a sigh, produced by expelling the breath from the lungs. If teased till out of patience, this was given out with the mouth partly open, when it had all the force of a warning; whether it was intended for that purpose or was merely preparation for a struggle, by lessening the bulk, are still to be considered. It really answered both purposes.

In regard to the nature of the venom and fatality of the bite there is little to offer that is new. The results of the experiments suggest danger for small animals but little or none for larger ones. Large angle worms and insects seemed to die much more quickly when bitten than when cut to pieces with the scissors.

Acquaintance with this specimen has satisfied me, however, that the reports of the deadly nature of the species are mainly exaggerations, with little if any foundation in fact. Popular opinion and for that matter its manner of origin are illustrated by the following, credited to Col. A. G. Tassin, U. S. Army, in the Overland Monthly: "The "Gila monster is an ugly reptile peculiar to Arizona, and "as its name implies, most common along the Gila river. "It is a sort of a cross between a lizard and an alligator,

"roughly striped black and white on a yellowish back-
"ground. Its length varies from ten to thirty inches, and a
"large-sized fellow is as thick as a strong man's arm.
"When prodded with a stick it hisses and thrusts out its
"heavy forked tongue, raising its head menacingly, but
"scarcely moving otherwise. Its bite is often fatal, the
"effect depending more or less upon the state of the sau-
"rian's temper and the depth of the wound. Its breath in
"hissing is offensive, and issues from a wide-open mouth
"in puffs of black vapor or smoke. The Mexicans I have
"questioned all told me that it was exceedingly poisonous,
"as much so as the bite, if not more, while many of the
"Americans thought it harmless. Having myself seen a
"chicken and a small puppy killed by the hissing of one
"in their faces, I am inclined to think that it is best to
"keep from coming in contact with it." Comment on this is unnecessary. Still more conclusive in its way is the following, originally from the Cochise Record, reprinted without comment in the Proceedings of the Zoological Society of London, 1888: "Sunday evening Dr. Mathews
"was summoned, by telegram, to Fairbanks (a railway-
"station near Tombstone, Arizona Territory, U. S. A.),
"to attend Colonel Yearger, who was reported seriously ill.
"Owing to delay in the telegram, the doctor did not reach
"the patient until several hours after his death, which had
"been very sudden."

"It appears that Yearger had been fooling with a Gila
"monster and in attempting to open the creature's mouth,
"was bitten on the right thumb. Instantly the poison took
"effect, and although every convenient remedy was ap-
"plied, he lived but a few hours. An inquest was subse-
"quently held, and a verdict returned in accordance with
"the above facts."

"As this is the third or fourth death which has occurred

"in the Territory from bites of this reptile, it should set "at rest, at once and forever, the theory so prevalent that "their bite is not poisonous."

For comparison with the foregoing we may bring forward the evidence of a couple of witnesses of scientific reputation. They have no interest in destroying the character of the accused and may be expected to give testimony without prejudice. If they are less positive in their assertions than the preceding, it is possibly due to their actual acquaintance with the creature.

Dr. F. Sumichrast under date of 1880, in the Bulletin de la Société Zoologique de France, page 178, remarks concerning *Heloderma horridum:* "J'ai peu de chose à "ajouter aux observations de moeurs que j'ai publiées sur "cette espèce, il y a quelques années, si ce n'est, qu'après "de nouvelles expériences sur sa morsure, je suis arrivé à "la conviction qu'elle occasionne rarement la mort chez les "animaux d'une certaine taille et que, la plupart du temps, "elle n'est suivie que d'une enflure de la partie mordue qui "disparait au bout de vingt-quatre heures au plus ; c'est au "moins le seul effet qu'elle ait produit sur plusieurs jeunes "chiens que j'ai fait mordre dernièrement."

Dr. R. W. Shufeldt is one who, from having been incautious enough to get bitten, is entitled to speak with some degree of assurance. His statement is found in the American Naturalist for 1882, page 908. He was bitten on the right thumb, the teeth going to the bone, by a specimen at the Smithsonian Institution. The lacerated wound was in a few moments the starting point of severe shooting pains that passed up the arm and down the corresponding side. A profuse perspiration was induced. The pain made him so faint as to fall. The hand swelled rapidly, but the swelling went no farther than the wrist. The treatment included suction which drew not a little blood

from the wound, a small quantity of whiskey, external application of ice and laudanum and a lead-water wash afterward to reduce the swelling. He passed a sleepless night. By the next day the swelling was considerably reduced and thereafter disappeared gradually. The following is the conclusion of the doctor's statement: "Taking "everything into consideration, we must believe the bite "of *Heloderma suspectum* to be a harmless one beyond the "ordinary symptoms that usually follow the bite of any ir-"ritated animal. I have seen, as perhaps all surgeons "have, the most serious consequences follow the bite in-"flicted by an angry man, and several years ago the writer "had his hand confined in a sling for many weeks from "such a wound administered by the teeth of a common "cat, the even tenor of whose life had been suddenly in-"terrupted."

The most conclusive of my own experiments on the subject of this notice, *H. suspectum*, eighteen inches in length, was made with a young cat less than one-third grown. The cat was bitten on the right hand and wrist, the lizard holding fast like a bull dog, and blood was seen to flow when they were released. That there might be no doubt of the effectiveness of the bite, in two minutes the teeth were inserted a second time, the saurian retaining his hold and sinking his teeth deeper as the cat struggled to get free. For half an hour or more the wound occasioned some distress and was licked and dressed by the kitten, which then went to sleep for about an hour and a half. In expectation of its death it was left undisturbed. To my surprise it awoke as lively as if nothing had happened. Though the hand was somewhat swollen, it was but slightly lame. Twenty-four hours afterward when it was as bright as ever and apparently without ill effects from its mishap, the same cat was again bitten twice on the fore-

arm, a little higher than before. As in the first experiment there was no room to doubt the penetration of the teeth. The cat again licked the wounds and for a considerable time was occupied in dressing them. There was no disposition to go to sleep as on the day before. In two hours, as soon as the cat was inclined to pay no farther attention to its wounds, it was killed and the skin removed the better to note the effects of the bites. The fore-arm and hand were found to be swollen to twice the size of the opposite hand and arm. The track of each tooth was marked by the blood in and close around it, and the number and depth left no doubt of the conclusiveness of the experiment; the teeth had gone to the bones and between them. I saw nothing by which to distinguish the cuts from those made by a needle. There were no signs of disorganization in either the first or the second bites. Nothing could be seen in the way of discoloration or otherwise to give reason for any other conclusion than that the kitten would have entirely recovered in a few hours, by the time the swelling had gone down, if it had been allowed to live.

The outcome of such observations as have been made on this specimen has been confirmation of the opinion that the species is venomous to a certain degree, to an extent that, while it may most often prove fatal to very small animals, is only in exceptional instances deadly or perhaps even dangerous to larger ones. The effect on the kitten was identical with that on the puppies in Sumichrast's experiments. That poison was introduced by the bite was evident from the distress and swelling occasioned.

Dr. Fischer has described and figured secretory apparatus on the lower jaws; no glands have been found on the upper. There is an important question to be solved in connection with this apparent lack of venom-secreting organs on one of the jaws, which is quite as well prepared for its use as

the other on which the glands are so well developed. On both upper and lower jaws each tooth has a lateral groove on each side; these furrows are supposed to be for the purpose of inserting the venom in the wounds made by the teeth. Unless there are, not yet discovered, means of supplying venom to the upper teeth, it is difficult to see how their furrows are made available, if not by means of a quantity set free in the mouth, from the lower jaws, before the attempt to bite, a process of such uncertain efficacy as hardly to be considered probable.

Averse to torturing the creature, no attempt was made to verify the statement made by Sumichrast concerning the habit of turning on the back to defend itself when struck or beaten with a club. However, it might be expected to do just what is asserted of it under such circumstances, for the position would be that which would enable it most effectively to use feet and claws in aid of the teeth in self-defence.

The breath is no more colored than that of human beings; neither is it nor could it be any more offensive in its odor than the incense wafted from the lips of multitudes of the representatives of proud humanity. In regard to the breath being venom-laden, that of the specimen before us certainly was not so; here again it would be no very difficult undertaking to select an army of men with whom a comparison in this respect would undoubtedly prove complimentary to the "monster."

And, finally, it may be said that unprejudiced consideration of the matter as it stands between the reptile and his detractors will not fail to convince any one that a great deal of the disrepute with which so much of the testimony is weighted should not by any means be attached to the lizard.

THE DIFFERENCES BETWEEN THE GEOGRAPHIC TURTLES (*Malacoclemmys geographicus and M. lesueuri*).

PLATE II.

BY H. GARMAN.

EARLY writers on our herpetology were not fortunate in their treatment of these turtles. Some did not recognize them as distinct, others considered them varieties of one species, while those who admitted their distinctness generally failed to make clear the differences between them. Most recent authors seem to have made use of characters furnished by early writers, and the result is that we have few descriptions which by themselves will enable us to say positively whether examples which come to our hands represent *M. lesueuri*, or its relative, *M. geographicus*.

The original description of *M. geographicus* (Le Sueur, Journ. Acad. Nat. Sci. Phil., I, 86, 1818) gives no characters by means of which this species can be distinguished from the later-described *M. lesueuri*. But in the accompanying figure (*ibid.* pl. V), Le Sueur shows the characteristic large head, massive jaw and a peculiar tympanal stripe. After publishing this description, Le Sueur became acquainted with *M. lesueuri*, and the elder Le Conte, writing some time later, stated that he seemed to consider it the one he had described as *Testudo geographica*. However this may have been, his figure in the Journal of the Philadelphia Academy will not permit us to believe that Le Sueur had anything in mind but *M. geographicus* when

he made his first description and figure. Le Sueur seems not to have published a description, with name, of the second species. That he finally concluded they were distinct species is shown by his manuscript name cited in the synonymy of *M. geographicus* by Dumeril and Bibron.

J. E. Gray published the name *Emys lesueuri* for the small-headed species in 1831, but afterwards concluded (wrongly) that he had redescribed Le Sueur's species, and in 1844 (Cat. Tortoises, etc., Brit. Mus., 21) gives his own name as a synonym of *M. geographicus*, Le S.

Both turtles are common in the Wabash river at New Harmony, the home for some time of Thomas Say, yet this naturalist recognized but one species in his paper on the fresh-water and land tortoises of the United States.

Dr. Harlan (Journ. Acad. Nat. Sci. Phil., 1827) gives a brief description under the name *Emys geographica* which applies to either species.

The elder Le Conte recognized two forms, but after describing them (Ann. Lyc. Nat. Hist. N. Y., III, 1828–1836, 108–111), he remarks, "there are not sufficient differences between the two to constitute them separate species."

Dumeril and Bibron (Erp. Gen., II, 1835) unite the two forms as one species, yet on page 259, we read "la tete est plate, élargie ; le museau, court, arrondi ; les machoires sont très fortes, à surface convexe, à bords droits, extrêmement tranchans et sans la moindre dentelure," from which it would seem that the head of *M. geographicus* alone was described. On page 260, *M. leseueri* is indicated by a mention of forms in which the dorsal plates are tuberculate. Gray's name is placed among the synonymy.

Holbrook gave, perhaps, the best account of the two species that has been published in this country.

De Kay evidently did not know the species well. His

descriptions may be arranged, for convenience in comparison, as follows:

M. geographicus.	*M. lesueuri.*
Head very large, with yellow stripes but no spots.	Head moderate, with yellow stripes and large, confluent blotches.
2.	2.
Shell not elevated, smooth, ecarinate, serrated behind, with irregular meandering yellow lines.	Shell elevated, carinate.
3.	3.
Feet and tail striped with yellow.	
4.	4.
Length six inches.	Size of preceding.

The descriptions are misleading in several particulars. *M. geographicus* always shows spots on the head. They are small relatively in large examples, but are always present and are quite characteristic. In young and half-grown examples they are almost as conspicuous as in *M. lesueuri*. *M. lesueuri* does not show confluent blotches on the head. Spots are always present, but they are very constant as to position and form, are always well-defined and never, as far as I have observed, merge among themselves or with adjacent yellow lines.

The shell of *M. geographicus* is carinated, conspicuously so in youth, quite evidently so in individuals of medium size, and a carina is not wanting from examples of large size. The remainder of the statement concerning the shell of *M. geographicus* applies equally well to the related species. The same thing may be said of the description of the colors of feet and tail. There are no essential differences between the two in respect to the color of these parts.

Adults of *M. geographicus* will average eight inches in length at least and are often as much as ten inches long.

M. lesueuri averages smaller, yet examples are frequently seen that measure eight inches in length.

The only statement concerning differences, therefore, that can be accepted without important modification is that with reference to the size of the head. The head of *M. geographicus* is very large; the head of *M. lesueuri* is relatively small.

De Kay's figure of *M. lesueuri* is good in the main, but the markings about the head, if correctly drawn, were from an unusually marked example. I refer to the two large, comma-shaped yellow marks on the side of the head posterior to the eye. In the majority of examples, at least, there is but one of these marks, the more anterior, and it is above the tympanum, never before or behind it.

Dr. Smith (Rep. Geol. Surv. Ohio, IV, 661) describes the "head, neck and feet" as slender in both members of the genus. The truth is that no member of the family Emydidæ occurring in the United States has a head larger, relatively to the body, than the adult *M. geographicus*.

The statement consequently applies to *M. lesueuri* alone. On page 662 of the same paper the species are characterized thus:

Head and neck with yellow lines, often reticulated, and a single spot on each side or none; keel not very prominent.—*G. geographica.*

Head with very large yellow blotches or stripes; keel very prominent.—*G. lesueuri.*

From this we are left to infer that there is a difference between the turtles with respect to the markings of the head. Yet as far as they relate to such markings the statements might be transposed without loss in accuracy. The head and neck of both are lined with yellow in much the same pattern. In the great majority of both species also

there is a spot on each side of the head behind the eye and, very generally, at least, only one.

The statements with reference to the keel of the carapace are right for adults. Excepting reference made to the keels there is nothing in the description which follows that will enable anyone to distinguish the species.

The statement concerning a yellow spot before and another behind the ear in *M. lesueuri* was, I suspect, drawn from De Kay's figure.

The synopsis of reptilia by Messrs. Davis and Rice (Bull., III, Ill. State Lab. Nat. Hist., 1883) introduces the expression "spoon-shaped dilation of the extremity of the lower jaw" as a character separating the two inland species from the east coast turtle, *M. palustris*. The expression does not seem to me to fit either of the fresh water species closely, and I have never known a student using a synopsis or description in which the expression was employed to place either of the turtles in the genus Malacoclemmys. The mandible of adult *M. geographicus* is greatly expanded, not especially at the tip, but as a whole; and in this respect it is approached very much more closely by the east coast species than by *M. lesueuri*. In the last-named species the mandible is not noticeably expanded and certainly is no more spoon-shaped than the mandible of species of Pseudemys. If the expression was to have been used at all, it should have been for the purpose of separating *M. geographicus* and *M. palustris* on the one hand from *M. lesueuri* on the other. The two former are not so closely related as are the two inland species, but so far as this one character is concerned are certainly more alike. The statement that the dorsal plates of *M. lesueuri* are imbricated while those of *M. geographicus* are not, is not strictly true. The plates are not imbricated in the proper sense of the word in either species.

The sutures between dorsal plates are always exposed, and the imbrication referred to is a slight projection of the dorsal tubercle posteriorly seen in some young examples. In adults this tubercle does not commonly extend beyond the posterior outline, and the posterior extremity of the tubercle is in some examples as far in front of the posterior margin of its plate as it extends in others beyond it. In addition to which the tubercles are quite evident in *M. geographicus* and in young examples may show a tendency to project beyond the posterior edge of the plates. The statement that the markings of *M. lesueuri* are less distinct was probably made after an examination of young examples. Of the two the adult *M. lesueuri* is generally most brightly marked. Exceptions to this may occur, but I think not many. Adult *M. geographicus* are certainly very obscurely marked, though still maintaining much of the original pattern.

Similar objections may be urged against the account of the geographic turtles in Dr. D. S. Jordan's Manual of Vertebrates.

The jaw is described as having a spoon-shaped dilation, and the dorsal plates are said to be imbricated in *M. lesueuri*. The descriptions are good so far as they go, but no important difference between the species is mentioned. To illustrate, I will run briefly over the first one given, that of *M. geographicus*. It is described as "dark olive brown with greenish and yellow streaks and reticulations, especially distinct on neck, legs and edges of carapace." This will apply equally well to the other species with the exception of the reference to the greenish lines. On large examples the lines on the head and neck assume this color, and I am not aware that they ever do so in *M. lesueuri*.

The plastron is described as "yellowish." This will serve just as well for *M. lesueuri*, notwithstanding that

the description of the latter which follows would lead us to infer that the color was here different (it is said to be "yellowish, marbled with blackish"). In young of both turtles the latter description is applicable, for they are then marbled beneath. For adults the description of *M. geographicus* with reference to this point is right, for both species are when mature of a dingy yellow color beneath, the marbling having been gradually lost during growth. The remainder of the description, "carapace strongly notched behind and usually decidedly keeled," applies to both species.

COLOR.

The ground colors and the pattern of coloration are very similar in the two species compared stage for stage. They agree almost line for line and spot for spot. Thus, while a casual look at the dorsal sides of the heads of two young, one of each species, seems to show that *M. geographicus* has more yellow lines on this part of the head; close looking shows that with several conspicuous lines on the head of *M. lesueuri* are others more obscure, and that in reality the lines are nearly the same in number and position as in the related species.

The mark which will in most cases serve to distinguish *M. lesueuri* from *M. geographicus* is a yellow, comma-shaped spot behind each eye. Each spot begins near the posterior border of the eye, in line with the nostril, extends inward, sometimes a little forward, then turns posteriorly still nearing the middle line and growing narrower and, finally, passing into a yellow line which extends posteriorly on the neck. Sometimes one or both of the spots are detached from the neck line. In some cases instead of curving uniformly towards the middle line the spots may be a trifle expanded and angulated opposite the dor-

sal edge of the eye. In other examples the tapering portion of the mark is lost and there is left only the body, forming a large spot behind the eye. The isolated spot in such cases is quite characteristic from its transverse position and bright color. A median dorsal line extends from the tip of the snout posteriorly gradually widening a little till opposite the posterior part of the eye, then gradually narrowing and fading to be lost, commonly, near the point at which the two comma-shaped marks are nearest each other, but sometimes continuing back upon the neck as a very narrow and faint line. At the outer extremity of the comma-shaped spot are several narrow curved lines which start from the ventral posterior edge of the orbit and expand posteriorly and ventrally finally to turn inward posterior to the comma-shaped mark and run parallel with it. Other similar lines also starting from the orbit extend ventrally and posteriorly passing across the tympanum and continuing along the side of the neck. The latter are frequently broken and may encircle the tympanum, leaving a pale central dash. A yellow spot is almost invariably present beneath each eye. Three spots on the mandible are noticeable from their position, one on the symphysis and one at each angle of the mouth.

The expanded posterior extremity of the carina of each dorsal plate is in this species distinctly black. In young this is the only black of the dorsal side of the carapace. Later in life, large imperfectly-defined black blotches appear, one at the posterior edge of each costal plate; other blotches still more obscure occur at the posterior edge of each marginal plate above. Besides these, there may be a pair of black dots, one on each side of the ridge of each dorsal plate.

The plastron in young *M. lesueuri* is very characteristically marked. The whole central region, embracing most

of its area, is occupied by a dusky spot with short rays of this color reaching out along the sutures between adjacent plates. This dusky area is closely lined with obscure pale stripes.

The head of *M. geographicus* shows a mark behind each eye comparable to that I have described for *M. lesueuri*. It is never comma-shaped and is generally, perhaps always, completely isolated. It may be circular in outline, but is more often triangular, elongated and placed longitudinally on the head. It is very commonly enclosed by a very faint pale line from which another narrow line extends backward upon the neck. A median line occurs here also. It extends posteriorly from the snout, gradually widening to its posterior extremity, which is on a line with or a little anterior to the anterior edges of the spots behind the eyes. On each side of this line is a couple of faint lines which in some cases turn inwards behind the median line where corresponding lines unite. In other cases the inner lines unite thus, while the two outer join to form a single median stripe which continues posteriorly upon the neck. The characteristic line of the side of the head is a rather wide one which originates on the tympanum and thence extends ventrally and posteriorly upon the neck. Sometimes it gives off a spur towards the angle of the mouth and still another at the ventral edge of the mandible. A small pale dot is commonly visible beneath each eye. Spots corresponding to those described as on the mandible near the angle of the mouth in the other species can be made out here. But instead of the spot on the symphysis is a median line which extends to the posterior edge of the mandible where it expands and divides into two lines which diverge backwards on the ventral side of the neck. The expanded posterior ends of the ridges of the dorsal plates are brownish-black in young, but not

as distinctly so as in the other species. In the adult they are quite black and are larger. On each dorsal plate is a pair of black dots, sometimes more. At the sutures between adjacent costal plates are dark blotches, but they are smaller and less distinct than in the other species. Blotches at the sutures between marginals are also present.

The plastron of young *M. geographicus* is, as a whole, paler than that of *M. lesueuri*. The black of this region is not in this species so closely aggregated nor so extensive. In some examples it forms about a dozen isolated spots, each with concentric lines of pale yellow alternating with the black. In other examples the black occupies most of the plastron, but the yellow areas within it give the effect of a yellow plastron marbled with black. In adults of both species the plastron is dingy yellow in color, sometimes with a trace of the dusky spots, but in large examples without any trace of the pattern which is so conspicuous in the young.

Apart from the features which have been mentioned, the two species resemble one another closely in color. The general color of the shell, body, head and limbs, the reticulation of the carapace, and the pattern in limbs and body furnish no ready means of distinguishing the species.

FORM AND PROPORTION.

In examples of young and adults which were measured, the depth of the shell was about the same for the two species. An average of the depth of four examples of each species, the two sets corresponding very closely as to size of individuals, showed *M. geographicus* to be a trifle deeper.

But a more uniform convexity of the carapace of *M. lesueuri* conveys the impression of a deeper turtle. Owing to this roundness of the carapace the length along the

ridge is greater in examples of the latter than in those of *M. geographicus*, the size of the examples compared being the same. The following measurements of two examples will illustrate this:

	LENGTH OF CARAPACE.	WIDTH OF CARAPACE OPPOSITE THIRD DORSAL.	DEPTH OF SHELL AT MIDDLE OF THIRD DORSAL.	WIDTH OF HEAD.	WIDTH OF HEAD IN ARCH ALONG RIDGE OF CARAPACE.
M. geographicus.	2.44 in.	2.25 in.	1.12 in.	.50 in.	4.75 times.
M. lesueuri.	2.37 "	2.19 "	1.06 "	.50 "	5.17 "

The median dorsal ridge is a trifle less prominent in adult *M. geographicus;* in young of the two species not much difference is apparent in this respect. A peculiarity of the ridge of the second and third dorsal plates in *M. lesueuri* will generally enable one to recognize this species. When viewed from the side the outlines of the ridges of these plates are seen to be concave before the posterior tubercles, whereas in *M. geographicus* the outline is pretty uniformly convex from the base to the posterior extremity of each plate. Most of the bony neural plates in *M. geographicus* are wider than long; the reverse is true of *M. lesueuri*, most of them being in it longer than wide. With these exceptions the carapaces of the two species are much alike.

In young examples the heads are about equal in size, but an examination of the jaws shows the alveolar surfaces wider in *M. geographicus*. The adult *M. lesueuri* has a rather small head, not larger than that of a Chrysemys, while the adult *M. geographicus* has a large head, with jaws quite as massive as those of the snapping turtles. The width of the head of an adult of the former was found to be contained 6.4 times the length of the cara-

pace. The width of the head of an adult *M. geographicus* measured, was contained in the length of the carapace 4.68 times. The most surprising difference becomes apparent on examining the jaws. The alveolar surfaces are in *M. geographicus* greatly expanded and when the horny covering is removed the underlying bones are found to be peculiarly modified, the maxillary and palatine of each side with the vomer forming a wide plate with elevated inner margin which almost meets its fellow across the middle line.

The mandible is correspondingly expanded and flattened. Having relation to this enlargement of the jaws is a widening of the skull behind the orbits and a thickening of the supra-occipital process, both having to do with the increased size of muscles necessary to operate the jaws.

M. lesueuri shows nothing of this expansion of the jaws. The alveolar surfaces are little if any wider than those of *Pseudemys elegans*, the anterior portion of the vomer is fully exposed, and there is no elevated continuous inner margin formed of palatines, maxillaries and vomer. Compared as to the jaws and the bones entering into them, *M. lesueuri* is more closely allied to Pseudemys or Chrysemys than to *M. geographicus*. I can only account for the failure of the early writers to observe the important differences in these parts by supposing that they did not have adult examples of the two species for examination.

FOOD.

The examination of the contents of the digestive tube of *M. geographicus* throws light at once in the modification of the jaws and head.

In all those I examined the food consisted exclusively of mollusks, in the young turtles consisting of *Valvata tricarinata* and other thin-shelled species, in the adults of larger and thicker-shelled forms.

Previous to examining the alimentary contents I had observed a worn appearance of the alveolar surfaces and numerous shining particles in the crevices, the meaning of which was now explained.

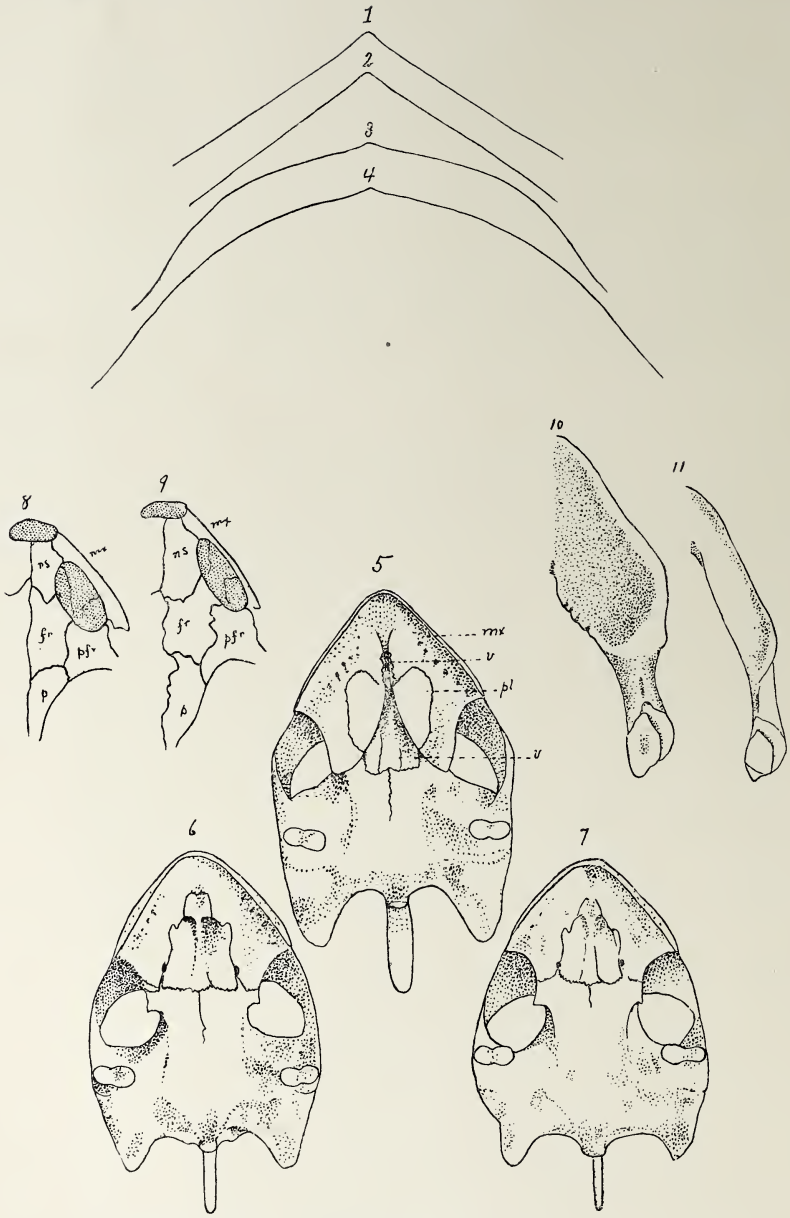
The digestive tubes of most of the adult *M. lesueuri* examined contained only the bulbs of a sedge which Prof. T. J. Burrill thinks is almost certainly *Cyperus phymatodes*. In some cases this species was found to have eaten cray-fish. Holbrook says it feeds on small fishes, reptiles, etc.

SUMMARY OF DIFFERENCES.

From the preceding matter the following characters may be brought together as serving for the separation of the two geographic turtles.

M. lesueuri.—Head small, width contained about 6.4 times in length of carapace. Alveolar surfaces of jaws not greatly expanded. Supra-occipital spine small, not thickened. Median ridges of carapace prominent; the dorsal outline of central dorsal plates concave before the tubercles. A comma-shaped yellow spot behind each eye, frequently continued posteriorly as a stripe on the neck. A yellow spot on the symphysis of the mandible. Averaging smaller than the following. Food mixed, animal and vegetable.

M. geographicus.—Head large, width contained about 4.6 times in length of carapace. Alveolar surfaces of jaws greatly expanded. Supra-occipital spine enlarged and thickened. Carapace with obscure median ridge; dorsal outline of central dorsal plates viewed from the side, a simple curve. Spot behind eye isolated, not comma-shaped, directed longitudinally. A stripe on symphysis of mandible. A stripe originating on tympanum. Larger than the preceding. Food, mollusks.



Malacoclemmys lesueuri, figs. 1, 3, 6, 8, 11.
M. geographicus, figs. 2, 4, 6, 8, 10.
Pseudemys elegans, fig. 7.

PLATE II.

EXPLANATION OF THE FIGURES.

FIG. 1.—Outline showing slope of carapace in young *M. lesueuri.*

FIG. 2.—Same of young *M. geographicus.*

FIG. 3.—Same of adult *M. lesueuri.*

FIG. 4.—Same of adult *M. geographicus.*

FIG. 5.—Ventral side of skull of *M. geographicus; mx*, maxilla; *v*, vomer; *pl*, palatine bone.

FIG. 6.—Ventral side of skull of *M. lesueuri* with same bones outlined.

FIG. 7.—Ventral side of skull of *Pseudemys elegans*, for comparison with Figs. 5 and 6.

FIG. 8.—Right side of skull of *M. lesueuri*, dorsal view; *mx*, maxilla; *ns*, naso-prefrontal; *fr*, frontal; *pfr*, post-frontal; *p*, parietal.

FIG. 9.—Same of *M. geographicus*, showing difference, especially between the frontal bones.

FIG. 10.—Right ramus of mandible of an adult *M. geographicus.*

Fig. 11.—Same of an adult *M. lesueuri.*

NOTE.—The observations of which the above is the result were made at odd times while connected with the Illinois State Laboratory of Natural History and are based chiefly on material collected by the writer in the Mississippi and Ohio rivers and their Illinois tributaries, but partly also on specimens collected or examined elsewhere in the United States.

A LOST PAPER ON HUGH PETER.

COMMUNICATED BY R. S. R.

The character of Hugh Peter, or Peters, has been the subject of a protracted controversy upon which it is not our purpose to enter. The partisans of Cromwell and of the Stuarts have in turn done what they could, on the one hand to elevate and on the other to blacken and defame it. The question is one to which Salem can never be indifferent, for the real character of the man, if it shall ever be finally established and vindicated, will be held amongst us as a precious heritage forever; or in the other improbable alternative, will endure as a conspicuous blot on our local history if the ugly imputations so freely bandied about amidst the courtly debaucheries of the Restoration are destined ever to be substantiated. The memory of Peters belongs in a sense to this town, for he not only ministered here with success between 1634 and 1642 but also interested himself extensively in ship building and in agricultural ventures, investing largely in real estate as well, acquiring at one time or another the land upon which the Pratt tavern stood and the Stearns Building was erected in 1792 and a number of other valuable tracts including, it is believed, the site of the Naumkeag Street Railway Office and the Joshua Ward house on Washington street, the house in which Washington slept in 1789.

His memory belongs too, in a certain sense, to the Essex Institute, for it is to that organization that the preservation of what remains of the church in which he preached has been committed.

Under these circumstances the possibility of securing for publication here an impartial and discriminating estimate of his character, not now in print, the mature work of one of the conspicuous writers of English History in the last generation, himself a Jew and an Israelite indeed who could regard the hot rage of Cavalier and Roundhead thus wholly removed from all bias and partisanship growing out of factions and antagonisms in the Christian Church, with the calm indifference of one whose creed allied him with the Mosaic era,—such a possibility when suggested possessed an interest not easily to be suppressed and prompted a series of efforts for the possession of the manuscript or a copy of it which have only just closed and which are here to be recorded. (See BULLETIN, XX, p. 56).

In Vol. II of the *Bibliotheca Cornubiensis* of the Messrs. George Clement Boase and William Prideaux Courtney, published at London in 1878, occurs, at page 474, amongst a list of works relating to the Reverend Hugh Peters, and filling nine of the large quarto pages of that exhaustive work, the following item:

"*A vindication of the Character of Hugh Peters, by* "*Isaac Disraeli, author of the Curiosities of Literature,* " *etc., MS.*"

"NOTE: This dissertation was to have appeared in con- "nection with the last edition of I. Disraeli's *The Life and* "*Reign of Charles I;* 1850: 2 vols. 8vo, but was acciden- "tally omitted. The MS. is still, 1875, *penes* his son, The "Rt. Hon. Benjamin Disraeli; *cf.* also, Curiosities of Lit- "erature (1858), i, p. xxxii."

In this prefatory chapter to the last edition of the Curiosities of Literature, dated 1848, but only issued in 1858, the Right Honorable Benjamin Disraeli, speaking of his father, says, "the last labor of his literary life was to vindicate the character of Hugh Peters."

My attention was called to these facts at Oxford, in an interview with which I was favored, in April, 1886, with the Rev. C. W. Boase, a fellow of Exeter College and a brother of the author. I afterwards availed myself of such means as lay in my power, from time to time, to trace out and, if possible, to secure for printing in our Historical Collections, so valuable a contribution to the local annals of Salem. But these efforts were without results until Mr. Lewis Fry, a member of Parliament for Bristol, visited the Essex Institute in October, 1888, and, interesting himself in the remains of the meeting-house in which Peters ministered, enlisted with ardor in the search. To him I am wholly indebted for such negative success,—apparently the only result possible,—as has at last been reached and I put on record these interesting communications in order to show that no effort has been spared, either on Mr. Fry's part or on mine, which could have led to the unearthing and publication of this unique production. Mr. Fry addressed himself directly to the Right Honorable Montague William Lowry-Corry, C. B., Lord Rowton, formerly private Secretary to the Earl of Beaconsfield and now his literary executor, with the following result.

GOLDNEY HOUSE, CLIFTON HILL, BRISTOL.
15th *Aug.*, 1889.

DEAR MR. RANTOUL:

You may remember that when we had the pleasure of seeing you last autumn you asked me whether I could ascertain from the late Lord Beaconsfield's literary executor whether Isaac D'Israeli's paper in vindication of Hugh Peters were in existence and whether I could get the original or a copy for your Historical Society. I did not at the

moment remember that the executor is Lord Rowton, formerly Mr. Montague Corry and Lord Beaconsfield's private secretary. After I got to town this spring I saw him on the subject in which he expressed a very ready interest and he promised that as soon as possible he would have a search made for the MS. among the very numerous papers in his hands. A day or two ago I received the enclosed letter from him. I am sorry my effort has not been more successful but you may be interested in having Lord Rowton's letter.

Yours very truly,

LEWIS FRY.

---

17 BERKELEY SQUARE, W.

August 12, 1889.

DEAR MR. FRY:

I am vexed that circumstances have, till now, made it impossible for me to execute the promise I made you in the spring, and that only to-day am I able to report to you the result of my search among the papers of Mr. Isaac Disraeli for the MS. in vindication of Hugh Peters.

As well as myself, my secretary, Mr. Seaves, has carefully looked them through, and I much regret to say that not a scrap relating to Hugh Peters can be found. Neither have we been more successful among the papers which have come to me from Lord Beaconsfield.

In fact, no such document, so far as I can learn, now exists.

It would have afforded me sincere pleasure, had my search been more fortunate, to offer the MS. to you for presentation to the Literary and Antiquarian Society of Salem. I am

Very faithfully yours,

ROWTON.

TO LEWIS FRY, Esq., M. P.

POSTMARK "STAVANGER."

September 5, 1889.

SIR:

Your letter of August 15th reaches me in a remote spot in Norway! It may be that, before this, you will have heard from our mutual friend, Mr. Lewis Fry, that I have, to my regret, failed after careful search (made with the object of gratifying your wish) to discover any trace or part of Mr. Isaac Disraeli's paper on Hugh Peters.

I am sorry to say that I am afraid that such a document no longer exists, since, so far as I know, all the remaining papers of Mr. Isaac Disraeli as well as of Lord Beaconsfield are in my hands. It would

have been to me a source of much pleasure to find myself able to satisfy the laudable desire of the Essex Institute to secure the publication of so interesting a bit of History.

I am, Sir,
Your faithful servant,
ROWTON.

To H. M. BROOKS, Esq.

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36 JAMES STREET, BUCKINGHAM GATE.
LONDON, S. W., 11 *Sept.*, 1889.

DEAR SIR:

Your letter of 28 Aug. to my brother the Rev. C. W. Boase of Exeter College, Oxford, has been handed to me as one of the authors of the Bibliotheca Cornubiensis. I perfectly remember the circumstances connected with the Hugh Peters episode to which you refer. In 1874 having become aware that Isaac Disraeli had written a vindication of Hugh Peters, although that vindication did not appear in his collected works, I wrote Benjamin Disraeli enquiring what had become of it. In course of time I had a reply from Mr. Disraeli's secretary, stating that it was quite true that his father had written such an article, which article was to have been given in the collected edition of his writings. By some unaccountable oversight it was however omitted, and now, 1874, although Mr. Disraeli had caused a search to be made for the MS. it could not be found, and he could not say what had become of it, but if it ever turned up he would let me know. I did not feel justified in pressing him further on the matter and I never heard anything more about it. I understand that all Lord Beaconsfield's papers were left unreservedly to Lord Rowton and if that gentleman has not come across the vindication in his researches I am much afraid that we must consider it to have been destroyed or at some time abstracted from its owner's possession. I agree with you entirely that it would be a most interesting document to print, and can but regret that it is not in my power to help you further in the matter.

I am
Yours very truly,
GEORGE C. BOASE.

ROBERT S. RANTOUL, Esq.
Salem.

BULLETIN

OF THE

ESSEX INSTITUTE.

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A STUDY OF SUMMER CEREMONIALS AT ZUÑI AND MOQUI PUEBLOS.

BY J. WALTER FEWKES.

THE present article is an abstract of a much larger work soon to be published in which I hope to treat in detail the several religious ceremonials which were observed by me at Zuñi Pueblo in the summers of the years 1889 and 1890. It is intended as a preliminary statement of observations on the externals of these ceremonials, leaving the interpretation of them to the more exhaustive account.[1] The substance of what is here given was brought out in a public lecture in Salem on the 24th of November, 1890, and a report of it appeared in the "Salem Gazette" of the following morning.

One word is necessary on the very threshold of our sub-

[1]The observations here recorded were made while connected with the Hemenway Southwestern Archæological Expedition.

ject in relation to the desirability or rather the necessity of placing on record all the data which can be gathered in relation to the religious customs of our Indians. The wholesale destruction of aboriginal religions by the early settlers has very much limited the amount of knowledge which we have of the characteristics of Indian ceremonies. In the case of our New England aborigines we have very meagre data bearing on this point. While fragments of their mythology can with great difficulty be gathered from the folk-tales of the survivors, and from the *ex parte* accounts which have come down to us from the writings of the colonists, who had no sympathy with "Devil worship," we have but little information of the nature and meaning of their religious ceremonials, or their forms of religious worship. With the growth of an intelligent interest in the study in a comparative way of the evolution of religion, it becomes desirable to have something more than can be gleaned from these sources. The best thing for us now to do is to endeavor to preserve what is left before that too is swept away into oblivion.

The inhabitants of a few of the pueblos of New Mexico and Arizona still preserve in a comparatively pure condition the religious observances and ceremonials of their ancestors.[1] The encroachments of the whites, and the inevitable changes which follow in the customs of the Indians, render it imperative that as many observations of these as possible be collected at once. Changes in ceremonials inevitably follow contact with the whites, so that it is highly probable that in no short time the religious observances at present practised will be modified or lost, and little

[1]That the Zuñians were formerly much more numerous is indicated by several facts. The large number of ruins of great size claimed by this race as belonging to their ancestors points that way, and the many folk-tales of persons dwelling in pueblos now in ruins look the same way.

remain to guide the future student in his researches on the indigenous or aboriginal religion of the southwest.

The primitive forms of religious observances which characterize these people and which have persisted up to the present are rapidly suffering great modifications, and unless efforts are made to record them permanently, in a generation or two they will be so much modified that the difficulty in distinguishing the ancient from the modern will be greatly increased. Without reflecting upon the excellent work which has already been accomplished in this direction it may be said that so much yet remains to be recorded that the field is almost a *terra incognita*. There is therefore a call for prompt action to secure the largest possible series of accurate observations of the religious ceremonials practised by these peoples before it is too late, and before the ceremonial habits of the race have been so changed that such records are impossible.

Of the several tribes of pueblo Indians, in New Mexico and Arizona, possibly the least modified in the particular which we are considering are the Moquis and the Zuñians. The former are the more primitive; the latter more easy of access. The present paper deals more especially with the latter, but references are not wanting to similar ceremonials observed among the former.

In the present state of our knowledge of the religion of the pueblos it is well to have some adequate even if didactic description of the ceremonies which are practised by them. It is therefore thought desirable to publish an account of those portions of the ceremonials which can be seen by all. A proper interpretation of those events is undoubtedly of still greater importance, but what is most needed at the present time is a trustworthy record of the observances as now practised. This article simply considers the events in a series of ceremonials as witnessed

by one who is not well enough acquainted with the meaning of the events to offer a satisfactory explanation of them.

The religious ceremonies which are here treated of are dances, and planting of prayer-plumes. There are also considered certain secular events which have a more or less religious nature in their performance. The Zuñians, as the inhabitants of other pueblos, are given to ceremonials, and every event in their lives has a religious side. As a consequence these observances are very numerous and varied and from the standpoint of a student it is difficult to separate purely secular celebrations from those of a sacred character.

Among the simpler ceremonials may be mentioned the planting of prayer-plumes, which are simple wooden sticks with feathers tied upon them. These sticks are either placed in the fields or deposited in special localities called shrines of which there are several in the neighborhood of the pueblo.[1] Two elaborate shrines are situated on top of a high tableland or mesa called Ta-yal-o-ne. These two shrines are dedicated to the Gods of War and the offerings upon them are quite elaborate. Their central object is a log of wood placed upright on which are cut rude human faces while other similar weatherworn logs are strewn about on the ground near the shrine. A cluster of prayer-plumes, some tied to the foot of the log, some upright in the soil in front of it, are offerings which have been

[1]One of the Zuñians told me that in old times there were two shrines in the pueblo near the old Spanish Church, now in ruins. A significant reminder of the Christian influence in Zuñi besides the old church is the cemetery in front of it where all the Zuñi dead are now buried without stone or inscription of any kind to mark their graves. In the middle of this walled enclosure stands a large wooden cross which was very dilapidated in 1889. At the beginning of last summer however this cross had been replaced by a new one and the adobe wall surrounding the grave yard had been renovated. As many skeletons are found buried in the floors of the old ruins even in Hal-o-na-wan on the opposite side of the river from Zuñi, it may be supposed that the present place of interment is a relic of Spanish influence.

placed there with ceremony. One of these, the offering of the Priesthood of the Bow, *Pith-la-she-wa-ney*, is a stick about six inches in length upon which is tied a miniature hoop with cotton network and small bow and arrows with small marine shells dangling from it. The enclosure in which these offerings were found was surrounded by an irregular wall of stones.

On the sides of the same mesa[1] there are several shrines in cave-like erosions in the rock. Some of these are simple rows of prayer plumes, great and small, while in others there are the skulls and bones of animals arranged with more or less regularity. Simpler shrines are numerous about Zuñi; some of them are small heaps of stones in the crevices of which are placed plumes; others have rows of prayer plumes deposited under an overhanging rock.

The shrine of *Her-pah-ti-nah* situated a few rods from Zuñi on the south side of the river near the site of the old town of Hal-o-na-wan is a rectangular rock enclosure with two chambers with entrances on the east side closed with flat slabs of stone. Within them there are offerings of sacred water, meal and feather plumes, while a few water-worn rocks are placed on the top of the shrine. This place is a sacred one to the Zuñians and was visited by them at the close of the *Ham-po-ney* dance, as later described.

Among the most conspicuous of the ceremonials of the pueblos are the sacred dances. The Zuñians preserve these observances in a comparatively primitive condition less modified probably by white influence than among those

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[1] Ta-yal-o-ne, or Thunder Mountain, is a most conspicuous table-land to the south east of Zuñi. With it are connected many interesting Zuñi folk-tales and at its base are the ruins of former pueblos. The top was once inhabited as the ruins there attest and to it the whole Zuñi nation has more than once retreated for protection against their foes. This gigantic mesa is difficult to climb, the trail on the side toward Zuñi being often cut in the side of the precipitous cliff. There are also shrines on the "Twin Buttes," Quil-le-yal-o-ne, to the north of Zuñi.

pueblos which are christianized. The summer dances are exceptionally interesting and present most valuable examples of Zuñi religious practices.

Three kinds of dances were observed by me in the summer months. Of the first kind, called the *Kor-kōk-shi*, there were several. There was a single tablet dance, the *Hay-a-ma-she-que*, and several corn dances called the *Kla-hey-wey*. One of these latter, known as the *Ham-po-ney* or *O-to-nar-wey*, which is celebrated after long intervals of time, has rarely been witnessed by white men, and as far as I know has never been described.

The above mentioned sacred dances are only incidentally times of merriment, but are occasions of earnest ceremonials, and have a profoundly tenacious hold upon the people. They are eminently sacred in character and well illustrate the ceremonial observances of this kind.

DU-ME-CHIM-CHE.

This ceremonial precedes the first of the rain dances and is celebrated just before the first *Kor-kōk-shi*.

The ten priests, who will later be described as the *Koy-e-a-ma-shi*, form in line each with his hands on the hips of the one in front of him. The leader carries his hands on his knees. The line assumes a slightly stooping posture and chanting in a monotonous way the words *Du-me-chim-che*, *Du-me-chim-che*, *ā-ā-ā*, slowly trots along around the pueblo, under the projecting roof of the first story. The course of this strange procession lies through the numerous lanes, around the open plazas and the outer row of houses of the town.

The participants are naked, without the characteristic mud masks, their hair hanging down their backs. They wear a single coarse cloth about their waists.

As this strange procession makes its way about the town

the women who have stationed themselves on the edge of the roofs of the lower stories throw upon the heads of the participants jars full of water, first taking a handful of the same and throwing into the air as an offering. Little girls imitate their elders, and in one instance I observed a woman sprinkle a little sacred meal upon the clowns as they passed along. At the conclusion of the ceremony they retire to their house and the ceremony is not repeated. It happened on the same or nearly the same date in 1889 and 1890, but in the former year it was a day before the first *Kor-kōk-shi*, while in the latter it was four days before the same observance.

On the morning of the fourth day before the first raindance, there left the pueblo three men marching abreast who took the trail leading to Ojo Caliente. These priests chanted a song as they left the town. Of the three one bore in his hands a bundle of feathers and another carried a whizzer or flat slab[1] attached to a string which he whirled about his head making a buzzing noise as he marched along.

These men are priests who go to the Sacred Lake to perform certain observances preliminary to the first raindances.

On the third day after their departure at about nightfall a procession of dancers approached the pueblo from the southwest. Their song could be heard long before they appeared and near their meeting-place on the foothills a fire had been kindled, the smoke of which could be distinguished from the town. The men who formed this procession did not accompany the bearers of the feather offerings to the Sacred Lake, but were seen leaving the pueblo in threes and fours dressed in their ordinary costume, in the middle of the same afternoon. They carried

[1] Called *Klem-tu-nu-nun-ey*, the wind. This implement is also carried by the mythical personage, Pau-ti-va.

their dance paraphernalia with them and dressed for the procession near the *rendezvous*.

The different persons who take part in the *Kor-kōk-shi* are (1) *Kō-kō* (2) *Lar-sho-wah-wey* (3) *Schu-la-wit-zer*, (4) ten *Koy-e-a-ma-shi* and (5) Bearers of the bundles of flags. The procession is headed by an unmasked priest who carries the sacred meal bowl and a feather wand.

KŌ-KŌ.

There are about forty men dressed to represent personages called by the Zuñians the *Kō-kō*. Over the head they wear a mask with a very long horse-hair beard. Upon this mask markings are painted and slits are cut in front of the eyes. Their own hair, carefully combed, hangs down their backs and in the crown of the head, feathers are fastened. A dependent string, weighted at the end, hangs down behind, on which also are tied feathers. Yellow and black feathers are placed in the hair.

They wear strings of shell necklaces and hanks of wool about their necks from which depends in a few instances the beautiful Haliotis shell, the well-known Californian "Abalone."

The upper part of their bodies and their arms are nude, somewhat daubed with a clay[1] or pink pigment on which, especially on the shoulders, zigzag markings were detected. These markings are said to be symbolic of water or rain. In one hand they carry a gourd rattle; in the other a sprig of cedar, a live turtle, or a flag leaf. The arm is ornamented with leathern wristlets[2] heavily set with coin silver

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[1] In certain Greek mysteries the initiated were daubed with clay. "This custom," writes Andrew Lang, "prevails in African mysteries, in Guiana, among Australians, Papuans and Andaman Islanders."

[2] *Chem-pas-sey-quin-ey*. It is an interesting fact that although the bow and arrow are very seldom used since the introduction of firearms the wristlet still survives as a popular ornament. Undoubtedly the former use of this was to prevent the string of the bow from striking the wrist in its rebound.

bands. Around the waist each *Kō-kō* has a ceremonial blanket reaching about half-way down to the knees and tied with a white belt with long, pendent, cord-like ends. In this belt are placed sprigs of juniper (cedar). From behind hangs down a fox skin.

The legs are bare with hanks of wool tied around them and anklets of cedar boughs. On the inner side of the knee-joint there hangs an empty turtle-shell with rattles made of hoofs suspended at the side by short buckskin thongs. The turtle shells serve as rattles by means of which by the motion of the leg an accompaniment to the dance is produced.

The song of the *Kō-kō* is melodious and begins with low notes rising to shouts and then sinking again to the original tones. In dancing there is no movement from one place to another, but a simple raising of the leg and bringing it down with force on the ground. The body is thrown slightly forward, the arms bent at right angles, the elbows of adjacent dancers touching each other.

LAR-SHO-WAH-WEY.

There are several men dressed as women who accompany the *Kō-kō* in the dance. They face the *Kō-kō* and dance with them.

Each of these wears a white blanket with ornamental border extending down to the feet. Their hair is adorned with two great rolls made of yarn one above each ear after the fashion of the Moqui women. They wear also the great silver necklaces which are ordinarily worn by women. Their legs are painted yellow, and they have not the turtle-shell rattles worn by the *Kō-kō*.

SCHU-LA-WIT-ZER.

There accompanies the *Kō-kō* a little boy called the

Schu-la-wit-zer who carries a fire-brand[1] made of cedar bark ignited at one end. He wears a rounded helmet and a quiver with arrows, and his body is spotted with polka dots of different colors. He is a God of Fire and in one of the dances performs interesting ceremonials in connection with it. The fire of his wand is said to be kindled in a primitive fashion, and he is said to burn everything which comes in his path.

KŌ-KŌ-A-WEE-LEY.

The leader of the dancers is a priest clad in an old fashioned Zuñi costume with face elaborately painted. He carries a beautiful feather wand in one hand and a jar of sacred meal in the other. He sprinkles the sacred meal along the line of the dancers and faces so as to look down the line of *Kō-kōs* as the dance progresses. Hanging over his shoulders he wears a string of empty turtle shells.

The director of the dance who begins the dancing and the singing is clothed like the other *Kō-kō* and has a position midway in the line.

KOY-E-A-MA-SHI.

These personages are ten in number and while they sometimes follow the dancers do not take part in the dancing. From their making fun of the various events in the dance they may be called the "clowns" and the curious masks which they wear give them naturally the name of "mud-heads."

The mud-heads are naked with the exception of a coarse cloth about the loins. Their bodies are daubed with mud so that they are about the same color as the houses by which they are surrounded. Around their necks they

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[1] The Zuñi name *op-si-ne* has been given me as that of the fire-brand of the *Schu-la-wit-zer*.

wear a coarse scarf and upon the heads a helmet or mask upon which are plastered great mud wens and eyes and mouth made of adobe. Their very appearance is ludicrous in the extreme.

They try in every way by action and words to amuse the lookers-on during the dance and at other times. On the day of its performance, at the close of the ceremonies, each of these personages is sprinkled with sacred meal by the leader of the dance beginning with the chief, the so-called father. Their peculiar satirical function calls to mind a primitive form of the theatre, a combination of amusement with the sacred ceremonials which is paralleled in primitive stages of culture among Aryan races.

In addition to the various personages described in the preceding pages as taking part in the first *Kor-kōk-shi* dance there followed the procession as it marched from the foothills to the pueblo a number of men with great bundles of flag leaves on their backs. These flags play an important part in certain ceremonies inside the houses at this time, and are distributed among the Zuñians.

Let me mention the sequence of events in the first *Kor-kōk-shi*. On the night of June 24, a procession of dancers, composed of the personages which we have mentioned above, marched from the southwestern foothills to the pueblo in single file, chanting or singing a song of a wild and primitive nature. When the procession approached the river bank on the site of the old ruin of Hal-o-na-wan[1] it halted and after some delay crossed the dry river bed of the Rio Zuñi and mounted to the town through the alley between the Zuñi gardens. The *Kō-kō* then formed in line facing the west; the *Lar-sho-wah-wey*

[1] The ruin of old Zuñi lies on the southern side of the Rio Zuñi opposite the present town which is called Shewena. The Hemenway expedition house stands on the site of the pueblo of Hal-o-na-wan, "The Ant Hill," which is contiguous to the shrine of Her-pah-ti-nah.

stood opposite them and both began the monotonous song and accompanying dance. The flag leaves, borne by the procession, were collected together and carried into a neighboring house and a squaw sprinkled the dancers with pinches of sacred meal.

After they had danced at the west side of the pueblo they marched to the small open space which opens in the north side, then to the Sacred Plaza, then to that west of the old Spanish church now in ruins, and finally at about ten o'clock in the evening to the estufa adjoining the house of the Cacique of the Sun. Here they unmasked and danced apparently the same dance as in the plazas, but as I was unable to enter I know nothing of their ceremonials in that room.

On the following day the *Kō-kō* and *Lar-sho-wah-wey* danced all day in the open places, passing at intervals into the estufa. A grand feast was given them about noon time in that place, the food being brought to them by their squaws.

The *Koy-e-a-ma-shi* kept up a continuous exhibition of their foolery in the Sacred Plaza during the day, a spectacle which was watched throughout the afternoon by the men, women, and children of the pueblo congregated on the neighboring housetops and in available places in the plaza itself.

Several *Kor-kōk-shi* dances occurred in the course of the summer, all resembling in general the one already described, but in none of them was there a procession of *Kō-kō* to the pueblo on the night before the dance or a visit to the Sacred Lake for water.

HAY-A-MA-SHE-QUE.

As the season wore on there occurred a tablet-dance[1]

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[1] So-called from the fact that the dancers wore painted tablets on their heads.

which differs quite essentially from the *Kor-kōk-shi*. The dance seemed to be in commemoration of the arrival of the corn personified in a being called the *Meat-ta-tash-a* or the "Long Corn."

In the late afternoon of the day before this dance I observed a single "*Kō-kō*" approaching the pueblo along the northern bank of the river.

He wore a long, white blanket with ornamented border and carried in his hands two long yucca palm leaves. Upon his head there was a rounded helmet, upon the apex of which projected a rounded stick tipped with feathers. There were also other larger feathers on the top of his head. Around his neck projected a thick collar of cedar boughs extending outward like a ruff. A bell jingled on his leg and there were elaborate moccasins on his feet. The *Meat-ta-tash-a* ambled slowly up the rise to the west of the pueblo upon which the corrals are situated and with low hoots entered the town unattended. He is a stranger, it is said, who has come to town and is at first treated as such. He made his way through the Sacred Plaza, up the lane which leads to the estufa adjoining the home of the Cacique of the Sun. He mounted the ladder and trotting around the sky-hole sprinkled here and there a little sacred meal uttering the low hoots which were the only vocal sounds he has made since he came to town. A moment later he descended to the room below and immediately squaws approached the sky-hole bearing bowls of food and great bundles of *He-we* or wafer bread[1] as if to bring him a feast.

On the next day there was celebrated a dance in which the *Kō-kō* wear tablets and in which the *Meat-ta-tash-a* takes a prominent part. In this dance the *Lar-sho-wah-wey*, known as *Nar-weesh*, accompany the singers with

[1] Probably interesting ceremonials take place in the estufa but I have been unable to witness them.

a rasping noise made by rubbing two sticks together one of which is notched and placed on an inverted empty gourd. The *Koy-e-a-ma-shi* play their pranks as in the *Kor-kōk-shi* and a great feast is held in the estufa at about noon.

Of all the personages who appear in this dance one of the most interesting is the *Ar-toish-ley* or the "Old Scold" who goes about the pueblo scolding every one whom she meets, declaring she will eat the children and kill the people. This woman wears a mask with face covered with spots. Her long gray hair falls down over her shoulders. She wears a black blanket with an old-fashioned wicker basket on her back. In her hand she carries a cane with a curved handle from which hangs from thongs a cluster of small hoofs which make a rattle as she emphasizes her scolding by bringing the cane down on the ground. Her legs are painted with round spots of variegated colors. Around her ankles are sprigs of green and her feet are bare. Many circumstances lead me to conclude that the *Ar-toish-ley* represents an old woman cactus picker, and theoretically I have supposed that she represents the olden times before the advent of the corn personified by the *Meat-ta-tash-a*. It is not impossible that we have here a dramatization of an historical event or an allegorical representation of the ripening of the corn in spite of adverse or evil influences personified in the Old Scold.

KLAR-HEY-WEY.

This is a woman's dance celebrated in a private house by eight women and one man, and as it is a dance in which corn is carried in the hand, may very appropriately be called a corn dance. I have seen the *Klar-hey-wey* on several occasions and every time it has on the whole the same general characters as follows:

On entering the room where the ceremony was per-

formed I found seated at one end eight Zuñi women elaborately dressed in holiday attire. In front of each was placed a basket filled with ears of corn heaped to overflowing. On either side were musicians and singers, the former seated about a basket covered with a white dance blanket from beneath which protruded the flaring ends of long horns, the latter about a native drum. The leading priests of the pueblo sat about smoking cigarettes which were lighted by a long fire-brand of cedar bark which was passed from one to another by Ni-u-che, the war-chief.

At a signal one of the dancers called the *Klar-ha-mosse* rose from her seat and quietly sprinkled a little sacred meal on the floor grasping in each hand an ear of corn and extending her arms at right angles began the dance. The singers who accompanied their song with a beating on the drum began their chorus and the dancer slowly edged her way to the middle of the room by means of a short sidelong movement, rising first on the ball of the foot and then on the toes slowly and silently keeping time to the song. She was followed by eight other women each with an ear of corn in either hand, with arms extended. There was also in the line midway in its length a solitary male dancer, scantily clothed, who also carried an ear of corn in either hand and who danced with a more rapid motion. Upon one of his knees a few bells were fastened which kept time to the music and song of the male singers.

The procession of dancers edged along sidewise to the middle of room, facing now in one direction now in another, slowly turning at a signal from the leader. Midway in their dance an old woman passed from one to another, taking the hands of the dancers in her own and drawing the corn which she held slowly across the mouth of the dancers two or three times.

After this ceremonial was repeated and the corn which she held brought to the mouth of each dancer, the dancing and singing going on at the same time, the line slowly withdrew to the corner of the room from which they had started, leaving a single performer behind who also likewise slowly edged her way back to her seat and as the music died out she gracefully waved the corn in the air, drew it across her mouth and deposited it in the baskets with those of her fellow dancers.

This was repeated shortly after, the dancers starting from an adjoining corner of the room, much the same as before except that the dance was accompanied with the horns as well as the drum with a new set of singers.

At nightfall the celebration of the *Klar-hey-wey* ceased and at its termination all present inhaled a deep breath as the singers left the room.

HAM-PO-NEY.

The most elaborate of all the dances by the women which was seen in my sojourn during the summer in Zuñi was a corn dance called the *O-to-nā-wey* or *Ham-po-ney*. This dance is in most respects not unlike the *Klar-hey-wey*, but is more elaborate and is participated in by all the Zuñians. It is celebrated very rarely and on that account a description of it has considerable value. When we reflect what changes come over the manners and customs of the pueblos in a few years we can readily see that those ceremonies which occur after long intervals of time are particularly desirable to describe. We do not know but that in another decade such a dance as the *Ham-po-ney* celebrated as it rarely is will be so modified that much of its primitive characters will be lost. It is, therefore, a profitable contribution to our knowledge of the ethnology of the Zuñians to record the present characteristics of the ceremony before the changes take place.

On the night before the *Ham-po-ney*, the *Koy-e-a-ma-shi* built in the sacred dance place a bower of cedar in which the dance of the morrow was to be celebrated. These priests cut the cedar from the hills at the south of the town and late in the afternoon came back to the place loaded down with great bundles of these boughs. With much raillery they decorated the beams of the bower which had already been built with cedar boughs, tying them on with grease-wood fibres. During this duty they were clad in the manner characteristic of this priesthood as already described.

On the morning of the dance, the bower was seen to be tastily decorated, and its whole interior occupied by seats for the dancers. There was an elaborate shrine in the middle of the building.

Two rows of blanketed seats extended down the middle of the house facing to the east. There were places for the women who later take part in the ceremonies. Between these seats there was made with sacred meal on the ground a terraced figure with apex pointing towards the east. On the eastern side of the house which was open, there was a line of four seats for as many women, the *Show-ko-mosse*, who take a prominent part in the dance. In front of them a line of baskets, heaped up with corn, was placed and a bank of feather plumes. A feather plume was placed in the ground near each seat.

The musicians sat on each side of the dancers. There were two sets of drummers and one squad who accompanied the dancers with the music of the horns.

The character of the dance was in general the same as that of the *Klar-hey-wey*. The dress, however, was much more elaborate and the paraphernalia more striking.

Eight women and one man danced in a row with a graceful movement of the body slowly edging their way from

the bower into the open plaza. They bore painted tablets on their heads and in their hands carried ears of corn and sticks upon which were tied feathers. Their arms were extended and swayed up and down as they went through the dance. The male dancer stood midway in the line and, when the women ceased, kept on dancing, raising one foot rapidly after the other. Brass bells rattled on his knees.

The ears of corn which each dancer held was drawn to the mouths of the dancers by several old women who performed that ceremony passing from one to another of the participants as described in the *Klar-hey-wey*. In the second part of the dance in which the musicians furnished the instrumental music, the dancers carried hand tablets similar to those which they bore on their heads.

The dancing was continued all day with the exception of a short time given to a feast when the dancers ate in the presence of the audience among whom the food was distributed after the dancers had eaten.

The dance lasted all night, during which a fire was kindled in front of the bower, and notwithstanding a heavy rain somewhat dampened the ground of the plaza, the dancing went on at intervals until daybreak.

In the morning a procession, composed of four boys and girls with Ni-u-che the representative of *A-hai-u-ta*, the war chief, and another visited the shrine of *Her-pah-ti-nah*,[1] marching three times around this sacred place. The slab which closes it on the east side was turned down, the chamber was opened and in it were deposited with prayers, offerings of feathers, water and meal.

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[1] I am told by one of the Moquis that they have a shrine similar to *Her-pah-ti-nah* which they call *U-wor-ton-nah*. It is said to lie in the plain beyond Wol-pi.

An interesting shrine at Teg-ua is the *Kar-ge* the "end of the trail," on the path up the side of the mesa from the spring. The "stone" in this is enclosed in a rock enclosure and is spirally coiled resembling a fossil.

LEY-LA-TUK.

Learning at the close of the *Ham-po-ney* that an interesting dance was to take place in the distant Moqui pueblo of Wol-pi, I left Zuñi on the following day and made a trip to this interesting pueblo. I was particularly anxious to see this dance, the *Ley-la-tuk*, because of its reported connection with the rattlesnake dance, since it is my intention to specially study this ceremony in some subsequent year. I, therefore, hurried away from Zuñi to Gallup and with a new "outfit" took the trail *via* Fort Defiance and Pueblo Colorado to the Moqui pueblos. I arrived under the shadow of the mesa upon which stands the first three Moqui towns, on the afternoon of Aug. 20, in time to witness parts at least of this most interesting and primitive ceremony.

The ceremony on the mesa began at sundown, but on my arrival at the pueblo in the late afternoon, the participants were assembled at a sacred spring in the plain below, where certain preliminaries were being performed. These I did not witness, but at a few minutes before dusk I observed a long procession winding up the side of the mesa to the town of Wol-pi, the most interesting of the three villages on the easternmost mesa of Moqui.[1]

About twenty persons took part in the ceremony at the well, and a few joined the procession after it reached the mesa top.

The line of participants marching from the spring to the mesa top was led by a priest who carried in his hand a

[1] It is a most desirable thing to study the character of the religious observances in the Moqui towns especially in Oraibe, the one which has least been influenced by the Americans and Spaniards. The Moquis have been studied with great profit by the Stevensons, Bourke, Stevens, Keam and others, but much yet remains before we can get at the true significance of their religious ceremonials. There is no subject in comparative religion which will better repay investigation than that of the ceremonial life of the Moquis.

basket of sacred meal. On his head he wore two horns, one on each side. A second carried a bowl of water and a feather wand. Two women and a boy followed.

The participants who followed the priests were scantily clad and many of them were painted. In their hair, on either side of the head, sunflowers were placed and around their loins there were sacred dance kilts or blankets. White streaks or bands were daubed on the body and along the sides of their legs. Each dancer carried in his hand a corn stalk with corn upon it. There were several naked boys in the procession who wore a profusion of shell beads, had horns tied to their heads, while their bodies were daubed with streaks of white. Behind the procession came two persons who carried bows in their hands and over their shoulders hung quivers filled with arrows. There was carried, likewise, a whizzer or a flattened slab tied to the end of a string, by revolving which they made a whizzing or buzzing noise. These men are said to correspond with the *Pith-la-she-wa-ney* or Priests of the Bow at Zuñi. They are known as the *Ka-lek-ta-ka*. The priests and boys with horns on their heads are called *A-lou-sa-ka*.

When the procession arrived at the open space which surrounds the pinnacle of rock where the snake dance is celebrated, it formed in lines with several abreast facing the rock and sung a low song without dance, the leader beating time with his foot. The song was accompanied with rattles and horns. The *Ka-lek-ta-ka* contributed to the song the noise of their whizzers which they whirled about the head. After the participants had sung their song at the edge of the open space around the rock pinnacle, they advanced a few paces and repeated the song and ceremony. This they did four times until they advanced to a lodge or bower, *She-hep-kēē*, built of cotton-wood in the middle of the place. Upon the rock upon which they stood the

well-known crescentric figures, symbols of rain, *O-mou*, were marked out with sacred meal.[1]

The offerings of water, brought by the boys, were then handed to the *Uch-che*, a man inside the bower, and having delivered the offerings the procession left the place. The man inside the bower, and a woman, buried the offerings in a little crypt in the floor of the bower under a flat stone. When I visited the place shortly after the ceremony I found that the lodge of cotton-wood had been removed and the flat stone, covering the cavity in which the deposit had been made, was plastered up with adobe.

These simple ceremonies were all that I saw of the *Ley-la-tuk* in my short visit to Wol-pi. I was told that there was a connection between them and the so-called snake dance[2] performed at about the same time in alternate years.

While the speculative side of my subject is one which at the present state of my knowledge of pueblo life I have endeavored to avoid, there is one prominent idea which has forced itself on my attention in studying the summer ceremonials of the isolated pueblos which I visited.

The character of the religious ceremonials in summer is more or less modified by the environment under the influence of which these Indians live. I think there is much to show that the mythological and religious character of the Zuñians can be directly traced to the physical and climatic conditions by which they are surrounded. As they are agricultural people the great desideratum at this time of the year is water for their crops. As a result, rain dances, *Kor-kōk-shi*,[3] are most prominent features. These

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[1] In a more detailed description to be published later, I shall give an account of how these rain figures were made by the priest, and the offerings which were thrown into them by the women and boys.

[2] It is desirable that, at the next celebration of this weird ceremonial, systematic efforts be made to bring to light the true meaning of the ceremony.

[3] Literally, good dances.

dances are said to be primarily for rain which is much needed in this arid region at this time. The same need of water has, no doubt, led to the visit to the Sacred Lake and the ceremonies connected with that event. Hence, also, the religious observances at the spring at the time of the *Ley-la-tuk* and the almost universal planting of prayer offerings in the fields.

In a study of the *Ley-la-tuk* at Moqui we have an interesting contribution to this line of thought. It will probably be found when the idea back of that strange ceremony, the snake dance, is thoroughly understood that it is connected intimately with the climate of the surrounding country.

The *Kol-o-wis-si*, or plumed serpent, one of the most powerful agents evolved in the mythological conceptions of the Zuñians, is a water being. All the waters of the earth are said by the Moquis to come from the udders of *Bo-ho-li-kon-ga*, a fabulous crested serpent, father of all life, as *Mu-ing-wa*, the earth, is its mother. To kill a snake is to destroy the sources of water, and snake worship is connected with water worship if such an expression may be allowed.

The importance which attaches to the Moqui ceremony called *Ley-la-tuk* comes from the suspicion that it is the same as the snake dance, and embodies all essential elements of the latter. There are good reasons to believe that these two ceremonies differing as they do in details are really the same, but that the *Ley-la-tuk* is the most primitive. The snake dance may then be regarded as an elaboration of the ceremony of *Ley-la-tuk* to which are added many secondary symbolic observances. The gathering, handling, and sprinkling of the snakes with sacred water and meal from obvious reasons have fixed the attention and become prominent or rather the most important things in the ceremony. The snake has thus come to give the name

to the dance, but it is by no means sure that the ophidian part of the ceremony is the most important; it is rather secondary, and in the simpler observance of *Ley-la-tuk* we have the primitive meaning of the observance which in the snake dance is masked or possibly lost. The snake is the guardian of the springs of the water, and as such is very properly carried in ceremonials for water, just as in the Zuñi *Kor-kōk-shi*, the live turtles, are carried in the hands of the dancers. One can readily see how the introduction of the live snake, effective as it is as a symbol, would in the elaboration of the observance lead to an undue development of a subordinate feature of the dance. Instead of a rain ceremonial it became a snake dance and as such is at present known to the majority of the Indians. The ceremonials connected with one of the symbols so overtowers the others that it conceals from sight the true nature of the observance. That is precisely, it seems to me, what has happened in the snake dance. I would regard it not so much an instance of snake worship, but as a rain or water ceremony in which the snake as a symbol of the sources of water, the springs, is introduced. The impression made by its introduction naturally led to the elaboration of all events connected with its capture, handling and introduction in the dance into ceremonials an account of which is given in such an entertaining manner by Captain Bourke. The idea behind this Moqui snake dance, once universal among the pueblos, now obscured by the display of living snakes carried in the mouth, is a ceremony for water in the springs of which the serpent is guardian.

The ceremony of *Ley-la-tuk* has all the essential parts of the snake dance except the ceremony with the snakes. It occurs at about the same time in the year on alternate years. From the nature of all the ceremonies in *Ley-la-tuk;* the exercises at the Sacred Spring in the plain, the

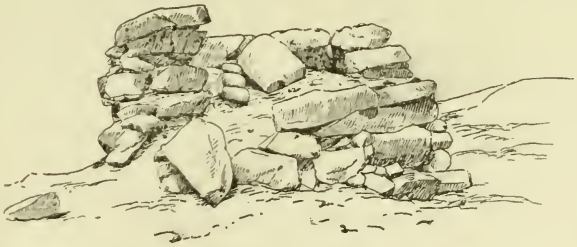
rain symbol on the earth, the Sacred Lodge, and the deposit of offerings of water in the receptacle below, there seems no doubt but that this dance is a rain ceremonial which has many other ceremonial ways of expression.

It is a noteworthy fact in this connection that the highest stages of culture on the American continent among aborigines is found where the climate is so dry and where nature has done so little for the agriculturist. The fertile well-watered valley of the Missouri and Ohio would seem much more favorable to the development of the agriculturist than the deserts of New Mexico and Arizona. There are more fertile regions in South America than those in which the Peruvian culture flourished. Possibly, the abundance of game in such regions rendered it less obligatory for man to become an agriculturist. He remained a nomad because game was plentiful, and as long as this source of food remained agriculture made slow growth. The arid deserts however, although less suited for cultivation than the bottomlands of the river banks, furnished only scanty hunting privileges. The buffalo could not be relied upon for food and man was forced to cultivate the soil. The moment primitive man became an agriculturist he became sedentary, and he began to live in settled abodes. Then would naturally arise a system of observances instituted to bring rain for crops and elaborate ceremonials be practised which would not arise among a race of hunters. Dry climates, for some unknown reason, have always had an influence in leading a man from a nomadic to a sedentary condition or from the hunter to the agriculturist, and many of the civilizations on the old continent have arisen in similar desiccated regions.

The writer believes that certain similarities in the religious observances of the pueblos to those of other primitive peoples inhabiting a desiccated country are di-

rectly traceable to the conditions of the region in which they live. To an agricultural people whose greatest necessity in summer is water for the success of the crops, it is perfectly natural that the similar systems of religious observances should arise. The human mind in early stages of its development in primitive society is the same, and would necessarily be affected in the same manner and would resort to similar observances. The powerful influence of observances practised in that stage in man's development, when he passed from the hunter to the agririculturist, would tinge all his subsequent religious growth.

If we analyze the climatic conditions which have exerted an important effect upon early beliefs an arid climate or one which sparingly supplies water may not be the least. The study of the religious observances in summer among a people who have not progressed out of the younger stages of growth, but who still live in such an arid region under conditions not unlike those in which sedentary habits first arose is therefore of more than a passing interest.



MOQUI SHRINE, *Karge*, "THE END OF THE TRAIL."

BULLETIN

OF THE

ESSEX INSTITUTE.

Vol. 22. Salem: Oct., Nov., Dec., 1890. Nos. 10–12.

Monday, May 19, 1890.

The annual meeting was held this evening at 7.30 o'clock; the President in the chair. The records of the last annual meeting were read and approved.

The *Secretary* read his annual report which was accepted and placed on file.

The *Treasurer* read his report on the financial condition of the Society; having been duly audited, it was accepted and placed on file.

On motion of Rev. E. B. Willson it was

Voted, That the thanks of the Essex Institute be tendered to Mr. George D. Phippen, the treasurer (who has declined being a candidate for re-election), for his faithful services during eleven years in this office. After remarks complimentary were offered by Rev. E. B. Willson, Dr. N. R. Morse, Mr. John Robinson and others, the vote was unanimously adopted.

The report of the librarian, Mr. C. S. Osgood, was read, accepted, and placed on file.

The report of the auditor, Mr. R. C. Manning, was read, accepted, and placed on file.

The report of the committee on nominations, T. F. Hunt, chairman, was read by the secretary and accepted.

Voted, That the meeting proceed to the choice of officers for the ensuing year. Messrs. G. M. Jones, Wm. L. Welch and Arthur R. Stone were appointed a committee to receive, sort and count the votes.

The committee reported that the following were elected unanimously:

PRESIDENT:

HENRY WHEATLAND.

VICE-PRESIDENTS:

ABNER C. GOODELL, JR.,
FREDERICK W. PUTNAM,
DANIEL B. HAGAR,
ROBERT S. RANTOUL.

SECRETARY:

HENRY M. BROOKS.

TREASURER:

GEORGE D. PHIPPEN.

AUDITOR:

RICHARD C. MANNING.

LIBRARIAN:

CHARLES S. OSGOOD.

COUNCIL:

WILLIAM H. GOVE,
THOMAS F. HUNT,
DAVID M. LITTLE,
WILLIAM MACK,
EDWARD S. MORSE,
S. ENDICOTT PEABODY,
DAVID PINGREE,
EDMUND B. WILLSON,
GEORGE M. WHIPPLE,
ALDEN P. WHITE.

Voted, That the committee on nominations be instructed to report at an adjournment of this meeting, to be called by the secretary, the name of a candidate for the treasurership.

THE RETROSPECT OF THE YEAR,

compiled from the reports read at the meeting and the remarks of the members in relation thereto, presents the work of the Institute in its various departments, since the last annual meeting.

FIELD MEETINGS. Two have been held with unabated interest during the past season; arrangements were made for holding others which were postponed on account of the unfavorable condition of the weather on the days appointed.

FIRST MEETING was held at Danvers, Thursday, June 20, 1889. A party of about fifty persons went in barges from the rooms of the Institute at 9.30 A. M. and visited the objects of interest, according to a programme furnished by Mr. Alden P. White and other friends.

First, the old Jacobs House situated on the banks of Waters River, the home of George Jacobs executed as a wizard in 1692. His grave is near by. The house is now occupied by the family of William A. Jacobs, a lineal descendant. It is a well-preserved old house; its low ceiling and the general appearance of the interior bear the mark of antiquity. Thence proceeded to Gov. Endicott's "orchard farm" upon which are the Iron works, the Porter mansion built by the Hon. Nathan Read; the old Endicott pear tree; the site of the Governor's house and the burying-ground; thence by the Collins' House which was the head-quarters of Gen. Gage in the early days of the Revolution, now the residence of Francis Peabody, Esq.; the grounds of the Peabody Institute; the House of Rebecca Nurse executed for witchcraft; the Nurse monument; the homestead of Judge Samuel Holten in the vicinity of the church of Salem village; the present church; the site of the First Meeting House where Rev. Samuel Parris preached and the site of the parsonage where the witchcraft delusion first broke out; the common at the centre bequeathed by Nathaniel Ingersoll as a "Training Field" forever; the beautiful grounds of the farm of George Peabody of Salem; Hathorne Hill and the Danvers Insane Asylum.

The barges then proceeded to the house of Dudley A. Massey, a most delightful place, where the company were entertained by the proprietor and members of the Danvers Improvement Society and upon his lawn the lunch was partaken of and the afternoon session was held.

About 2. 30 P. M. the meeting was called to order by the President who stated that it was forty years, this month, since the first field meeting of this society was held; of those who attended, about fourteen in number, only three or four survive; they came in private carriages and visited portions of Wenham and Danvers, the meeting was held in one of the parlors of Berry's Tavern in Danvers Plains and was entirely of a botanical character. Dr. Andrew Nichols, Rev. John Lewis Russell, Messrs. G. D. Phippen, S. P. Fowler and others were among the speakers. Three other meetings were held that season: one at the house of A. T. Newhall in Lynnfield, one at Knowlton's near the ponds in Hamilton, and the third at Smith's point, in Manchester.

Mr. Geo. D. Phippen, being called upon, gave a further account of the first meeting in 1849, with personal reminiscences of those who took part.

Rev. C. B. Rice, of the First church in Danvers, was then introduced. He spoke at some length on the subject of witchcraft. He exhibited the old church records kept by Rev. Samuel Parris, also a piece of a board from the Parris House.

William P. Upham, Esq., followed Mr. Rice on the same subject. Mr. Upham thought the lack of a good education was the main cause of the witchcraft delusion. That the first settlers in this region were men of culture for the most part, but after one or two generations had passed, there was a decline in knowledge and common sense. This, he said, had been confirmed in various ways:

records, documents, letters, etc., all showed a rather illiterate people at the time of the breaking out of the witchcraft.

Mr. John H. Sears was the next speaker. He exhibited and described certain plants of the locality where the meeting took place. He also gave a botanical record of Essex County, with the names of those who had published lists of plants from time to time.

At this point, a discussion sprang up regarding the national flower, Mr. Phippen advocating the Kalmia. He was followed by Rev. Mr. Rice to the same effect, and Rev. Mr. Ewing of Danvers who offered a vote proposing the Kalmia, as the national flower, which was adopted.

Mr. Alden P. White read a letter from Whittier, dated at Portland to his cousin at Oak Knoll, regretting that he was not able to be at home to welcome the Essex Institute. Mr. Whittier said, "Danvers will feel honored by the visit, and I am sure all its citizens will do all in their power to make the occasion one of pleasure and interest. The Institute is creditable to our county and has already accomplished much, and its prospects of future growth and usefulness are full of encouragement."

Mr. Massey expressed pleasure at the visit of the Institute and referred to its work, saying that one object in life he believed to be the elevation of man and he was glad to welcome the society himself and in the name of the Danvers Improvement Society.

Mr. N. A. Horton offered the following vote which was unanimously carried.

Voted, That the thanks of the Essex Institute are due and are hereby tendered to Dudley A. Massey, Esq., President of the Danvers Improvement Society, in behalf of that society, and to Mr. Massey for the use of his beautiful grounds for the meeting of the Institute; also to the

Improvement Society for the exceedingly bountiful collation furnished by them to the Institute and its friends and the thanks of the Institute be also tendered to Alden P. White, Ezra D. Hines and Andrew Nichols, Esqs., for their attention and kindness in pointing out places of interest on the route from Salem to this place; also to those persons who opened their residences to the inspection of the members of the Institute; also to the proprietors of the First Church for the privilege of visiting their church and to all others who have contributed to the interest of the occasion.

The meeting then adjourned. At 4.30 P.M., it was announced that the barges were in readiness for the homeward trip; on the way to Salem, the party visited the birthplace of Gen. Israel Putnam of the Revolution, where, in the room in which the general was born, is an old chair which had belonged to him. This house was built in 1648 and was therefore rather an old house when the general was born. The party passed the house of Sarah Osborne, one of the first accused of witchcraft; they also made a call at Oak Knoll. Besides the number who went in barges, several went by horse cars and private carriages.

THE SECOND FIELD MEETING was held at Ipswich Bluffs on Thursday, Aug. 22, 1889. The weather was remarkably pleasant, one of the finest days of the season. The party of some seventy persons left Salem at 10 A.M. for Ipswich where, upon arrival, barges were taken to the steamer "Carlotta" which, after a pleasant sail, landed the party at the Bluffs. An hour or two was passed in rambling about the place looking after any objects of interest that might turn up and enjoying the fine air and scenery. At one o'clock a large portion of the company who had taken baskets spread their lunch in an old-fashioned barn and

partook of refreshments in a primitive way. A few dined at the hotel. At 2.30 P.M. the meeting was called to order, the president in the chair. In the absence of the secretary, who was detained at the rooms in Salem, Capt. George M. Whipple was chosen secretary *pro tem.*

Prof. E. S. Morse was the first speaker; he discoursed upon the shell heaps found in this vicinity. He thought they were of great age; one proof of their antiquity mentioned was that the bones of the great auk, a bird now supposed to be extinct, are found in great abundance in these heaps. These birds were once numerous, but only a few specimens are now preserved in any museum. A molar tooth of a polar bear has been found in heaps near Portland or Portsmouth showing that the heaps were made when the climate was cold enough for that animal many centuries ago. Professor Morse also spoke upon the gradual change in the shape of the clam, attributed to a change in the climate of these regions.

Abner C. Goodell, jr., was the next speaker. He spoke of the value of old records; regretted that the earliest people did not make any record of their lives and habits. He compared the present modes of recording and presenting the facts of history to the limited opportunities of the olden times. The art of photography, had it been in use in the early days of New England, would have preserved to us views of great interest and value. John Smith in 1614 mentions "Plumb" Island and said it was covered with mulberries probably mistaking those trees for plum trees. Baker's Island, Mr. Goodell said, was named for Isaac Baker, who was killed on that island while felling a tree. He said the imperfect account of the early years of America should teach us of the present time, faithfully and fully to put on record the events great and small of to-day.

John H. Sears spoke in reference to the peculiar geo-

logical formation of the locality and of Essex County in general, the rocks along Parker river showing the oldest geological formations of the county, while the sands and marshes of Plum Island show the latest; Mr. Sears also spoke of the glacial period as connected with this locality.

George D. Phippen was next called upon and he gave some interesting information about the formation and development of the common fruits.

J. J. H. Gregory of Marblehead said he was an "old timer" at the Field Meetings and was astonished at the new ideas advanced by the younger men now in the field, and said that he was inclined to go back to his books for new instalments of knowledge. He believed that he was one of the first to examine the shell heaps of this vicinity. He complimented Mr. Sears for the work he had done in Essex County, and hoped he would publish his results. He also believed that the Norsemen were the discoverers of this continent centuries before the English came here, and gave some reasons for his belief.

Mr. L. L. Dame of Medford, a member of the Middlesex Institute, was requested to say a few words. He said "Middlesex takes off its hat to Essex." Essex he considered the pioneer in historical matters.

His remarks were upon the trees on the island in early times. Most of the islands were thickly wooded, and he deplored the extensive cutting away of the trees not only on the islands but in different parts of the country. He approved of the establishment of public parks and spoke particularly of Middlesex Fells. Hoped that the islands of our bay could be planted with trees.

Mr. Gregory asked Mr. Sears to state what trees grew on House Island off Manchester shore, the only island in this vicinity which is covered with a healthy growth of wood.

Mr. Sears said the island was covered with bass, cedar, red oak, ash and white oak. On Eastern Point the trees are vigorous and hardy, some are large and lofty, red maple, oak, ash and hickory. He thought the growth could be recovered by liberally re-seeding, and instanced successful experiments which had been made at Rockport where he himself had planted a peck of acorns.

The meeting adjourned in season to take the steamer for Ipswich, at which place the party took the cars for Salem, at 5.59 P.M.

REGULAR MEETINGS were held on the first and third Monday evenings of each month. At some of these and also occasionally on intermediate Monday evenings, the following lectures were delivered.

Monday, Nov. 18, 1889.—Mr. William Cranston Lawton, of Cambridge, secretary of the Delphi committee of the Archæological Institute of America, lectured on the "Proposed excavations of Delphi in ancient Greece." The Gazette says, the lecturer "spoke enthusiastically of the importance of studying the ruins of the past, where, in art, three great qualities were always foremost: simplicity, truth and beauty. The American school in Athens, now seven years old and wholly supported by subscriptions, was described and the importance of its work in literature and art fully shown, the enthusiasm of the students being such that many have voluntarily and at their own expense carried on the excavations of ancient Delphi, long the religious centre of the Greek world famous for its oracle and temple, and a power political and intellectual; there remains simply the outlines of its terraces, while a straggling village occupies the site of the temple. A long section of the foundation wall has already been uncovered revealing more than seven hundred inscriptions cut in the

rock, a mode of recording events and which are now of great interest. It is the design of the society to raise the necessary funds and then, with the permission of the Greek government, buy and remove the village when it is believed excavations will reveal to the world treasures of inestimable value."

Monday, Dec. 2, 1889.— Hon. Eben F. Stone read an interesting paper on Gov. John A. Andrew, "the Massachusetts war governor."[1] Mr. Stone knew Gov. Andrew intimately and had a high opinion of his character and talents. The paper was well written and was full of reminiscences and personal recollections of one of the most popular men of his day; and perhaps one of the best governors we ever had in Massachusetts. He appeared to be like President Lincoln "a providential man" and moved the masses of the people by his eloquence and power.

Monday, Dec. 16, 1889.—Rev. G. T. Flanders, of New Bedford, read an instructive and interesting paper on Mohammed and Mohammedans, giving some account of the state of religion and especially of christianity at the beginning of the career of Mohammed in A. D. 610, and then reviewing his life and character very fully. He did not regard the prophet as either an impostor or a lunatic, but a providential man, a man for the times, true to his mission, so to speak. He also gave some account of the Koran and its doctrines, showing a thorough acquaintance with his subject.

Monday, Jan. 20, 1890.— Rev. A. P. Putnam, D.D., of Concord, delivered an interesting biographical sketch of Gen. Moses Porter "an unrecognized hero of the Revolution" who was born in Danvers in 1756, enlisted in

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[1] See Hist. Coll. Vol. XXVI, p. 1.

Captain Trevett's Marblehead company of artillery immediately after the battle of Lexington. He fought at Bunker Hill where he exhibited a good deal of courage, was with General Knox at the siege of Boston and fought through the war having been wounded at Fort Mifflin. He afterwards fought the Indians in Ohio. In the war of 1812, he was the first to plant the American flag at Detroit. His brilliant achievements in that war gained for him steady advancement in rank.

Monday, Jan. 27, 1890.— Mr. Ezra D. Hines of Danvers delivered an interesting lecture on "The March of Arnold from Cambridge to Quebec" early in the Revolutionary war. He described the condition of things at Cambridge when General Washington first took command of the army. Arnold's plan to capture Quebec was an important one, but was considered bold, yet had the sanction of Washington and other generals. The army left Cambridge in two battalions Sept. 13, 1775, one under the command of Lieut. Col. Christopher Greene and the other under Lieut. Col. Roger Enos. The battalions followed each other a few hours apart and travelled over the old Ipswich road to Newburyport. Arnold himself followed two days later. From Newburyport the army proceeded in vessels to the mouth of the Kennebec. Here they separated into divisions, a squad of ten men under command of Lieut. Archibald Steele going in advance of the main army. The army proceeded in batteaux up the Kennebec and over carrying places until they reached the great carrying place from the Kennebec across to the Dead river; up the Dead river to another great carrying place and then to the height of land separating the waters running south into the Atlantic from those running north into the St. Lawrence; over this and on to Chaudiere pond, then on

and around the Chaudiere river through Canada to Point Levi opposite Quebec. From here they crossed the St. Lawrence to Quebec, ascending the plains of Abraham and remaining there for a short time; then proceeding up the river to Pointe-aux-Trembles, where they were afterwards joined by General Montgomery; the two armies then proceeded up the river and attacked Quebec where Montgomery was killed, Arnold wounded and many of the soldiers killed, wounded or taken prisoners; and what was hoped to be a victory was turned into a defeat. Had Arnold been successful in this expedition, it might perhaps have so changed subsequent events that he would not have been a traitor to his country.

Monday, Feb. 3, 1890.—Rev. Charles B. Rice of Danvers lectured this evening on "Aluminum—Prose and Poetry." He stated that the metal was very abundant, but so mixed with oxygen that it was hard to be got out. It used to be worth $100 per pound. Many of the precious stones are largely composed of aluminum, as sapphire, ruby, topaz, moonstone, etc. It is also in many common minerals and earths; a ton of good clay might contain from $600 to $800 worth of it.

The progress that has been recently made in separating aluminum from other metals and its great abundance have led some enthusiasts to predict that we are on the verge of an "aluminum age," and that great possibilities with the metal lie before us but just what possibilities remain to be seen. It is very light for a metal, about the same weight as an ordinary stone.

It does not rust, is not affected by sulphur or acid, does not tarnish, and is not poisonous. Its strength is much less than iron. It is not easily worked and does not take hard or soft temper like steel; so that it looks as if "the

goddess of industry would continue to wear the iron crown."

It is now chiefly worked as an alloy, its combination with copper making a compound much stronger and more elastic than either metal. It is mixed with copper in the proportion of one to ten. It has also been used in this alloy to imitate gold chains and watch cases, and wears well without tarnishing. As a bronze it is used for cannon, sheathing vessels, in dynamos and other electric appliances, and is the material used for the cap of the Washington monument.

Monday, Feb. 10, 1890.—Col. Henry Stone of South Boston lectured on the character and career of Major General George H. Thomas. General Thomas was a native of Virginia, and proud of his state. Graduated at West Point number twelve, in a class of forty-two, General Sherman and General Lee being of the same class, Sherman ranking six. He served in the Florida and in the Mexican war with high honors. On the breaking out of the civil war, he refused high rank in the Confederate service, cut aloof from his closest associations, was pronounced an alien enemy by the legislature of his native state, and his property confiscated.

The lecturer traced Thomas' course through the civil war, referring to his brilliant defeat of a confederate force of twice his numbers at Mill Spring. At Chickamauga, his gallant fight against great odds, and the maintaining his position, won for him the recognition he had so long deserved. Immediately after, he succeeded to the command of the forces at Chattanooga, and held the place through a most trying siege which ended in the sweeping away the enemy from Missionary Ridge in a brief and heroic action on Thanksgiving day, 1863.

General Thomas' command did the heavy work in the advance upon Atlanta where he lost thirty-two per cent of his sixty thousand men. Then he turned back to Nashville, Tenn., being closely followed by Hood, and soon after arriving in that city, where he was reinforced by fifteen thousand of Grant's men, he attacked Hood's army and in a short engagement so demolished the enemy that it did no further effective service as an army. For this he was promoted to the rank of major general by the secretary of war, and here ended his military career in the field, though he planned important campaigns in Georgia and Alabama. He was a great favorite with the lecturer who had opportunities of knowing his character, having at one time been on his staff.

General Thomas was mentioned in connection with the Presidency in 1868 but promptly declined to have his name used for such a purpose.

Professor F. W. Putnam of Cambridge, delivered a lecture on "Pre-Columbian America," or the race of men which existed in America before the coming of Columbus. The lecturer said that there were people here long before the discovery of Columbus, and it had long been a question who they were, and whence they came. They, or one stock of them, probably were the descendants of men who, ages before, came from very nearly the same place from which the great discoverer started and so when he sent some of those whom he called Indians, but really the Caribs, back to his own home, he was simply sending them almost to the starting point of their race. Mr. Putnam alluded to the glacial period and the immense gravel deposits following it, and in those gravel banks were found implements and traces of a human race, showing that man existed thousands and tens of thousands of years ago, here in America. He differed from the generally accepted the-

ory that these people with their more than eighty distinct languages, all sprang from one race. There was one type on the Pacific coast which had developed and attained a high mental culture long before the other and different race had shown itself on the Atlantic coast.

There is the strongest evidence that people were living south of the great glacial belt, at the period of the gravel deposits with the Mastodons and Mammoths.

The Professor illustrated his lecture by many excellent lantern pictures including views of the skeletons of the longheaded type of the human race which occupied the northeastern coast, and were found a few years ago buried at Winthrop, Mass. He placed the time of these burials at from 1620 to 1630. In the vertebra of one was found a brass-headed arrow the head of which had penetrated the bone. This brass head indicated contact with the whites.

Monday, March 3, 1890.—Hon. William D. Northend delivered a lecture on the administrations of Conant and Endicott. The lecturer began by saying that the terms used to distinguish the first settlers of the Massachusetts Bay Colony from those of Plymouth were misleading—Puritans and Pilgrims. The term Puritan had been applied to the non-conformists, the separatists, the presbyterians under the long parliament and the independents under Cromwell, and the word pilgrim had no significance in explanation of the religious views of the settlers of Plymouth. They were separatists and the settlers of Salem and Boston were non-conformists, and these were the terms he should use in reference to the different settlements. He described the class known as separatists or Brownists, from the name of Brown, their founder. They differed essentially from the non-conformists in that they

refused to acknowledge the supremacy of the national church, withdrew from its attendance and set up a separate worship in conventicles of their own. The conformists and non-conformists united in opposition to this class as tending to disorder and faction. The lecturer said, in describing the non-conformists, that they detested the forms and ceremonies of the established church as adopted from the Roman church, and to the bishops' courts and the court of high commission through which their observance was empowered. They claimed that these forms and ceremonies were not authorized by scripture — that they were the inventions of men, and that to observe them was idolatry; but this did not affect their regard for a loyalty to the church itself. They were members of it. They subscribed fully to its doctrines and to the ecclesiastical unity upon which it was based. In all essentials they were sincere churchmen, and they did not love the church itself less because of obnoxious forms and ceremonies imposed upon it. They lived in an age when it was the general belief that it was impossible for different sects to exist in the same community without such conflicts as would endanger the peace not only of the churches but of society. The day of toleration had not dawned. To them toleration was not only mischievous but sinful.

The lecturer gave an interesting account of the settlement of Cape Ann made by a company from Dorchester, England, who for some years had been engaged in fishing on the New England coast. The fishing experiment not proving successful, and the land at Cape Ann not being suitable for planting, Conant in the fall of 1626 removed to Salem, "a pleasant and fruitful neck of land," under encouragement of Rev. John White of Dorchester, England, who took great interest in the enterprise. Endicott came over from England in 1628 with a company and took

charge of the settlement. A charter was obtained in 1629 from King Charles to the company, giving powers of government. Encouraged by the new grant from the king, large additions were made to the company by non-conformists from different parts of England, including many of the gentry and wealthy merchants, with a view to a large emigration. Winthrop was elected governor and large preparations were made for the great emigrations which took place in the spring of 1630, when some fifteen hundred people came over. In regard to the establishment of an Independent church here, Mr. Northend said it was with the knowledge and consent of the king.

Monday, March 17, 1890.—Mr. James F. Almy delivered a lecture upon "The Quaker ascendancy in the town of Adams, Mass." The Quakers of Cape Cod and Providence Plantations went to Adams from 1776 to 1800, buying out the original settlers. Many of these Quakers were of illustrious English ancestry. They brought with them to Adams a home life which was perfect, for its division of labor rendered them independent of every other home. They could make everything they needed. The adult membership of the society was over one hundred, and the affiliated membership was twice as great. The children of Friends are members of the society by right of birth. The Friends started a free school system there. At Adams they found conditions very different from those of our day. No progress had been made in manufactures. It was an age of handicraft when every home was a scene of constant, intense industry; every family must produce everything necessary to itself, when the land produced not only the food, but the staples for clothing. The women spun and wove the flax and wool, dyed the web and made the garments, while carrying on the thousand interests of

the household, including the dairy. The men were engrossed in the outside cares of the farm and home, yet maintained high intelligence and character. The lecturer said the Quakers of Adams maintained the first successful cotton factory in America. The Arkwright invention, now about 100 years old, was brought to America in Samuel Slater's brain in 1789. Hearing that a firm in Rhode Island had made some attempts at cotton spinning, he wrote from New York, and received the following as part of his answer: "If thou canst do this thing, I invite thee to come to Rhode Island and have the honor and the profit of introducing cotton manufacturing in America." Slater did enter the firm of Wm. Almy and Smith Brown and with them began the successful era. The Quakers of Adams were the first to set up successful cotton manufacture outside of Rhode Island. Their social life was simple and pure.

Monday, March 24, 1890.— Sidney Perley, Esq., of this city, delivered a lecture on "Old-time winters in Essex County," a subject to which he had given special attention, and had gathered a large fund of information from old diaries, records and newspapers. The lecturer spoke of the watch, church services, dress, food and schools of the early winter seasons; how the people spent their evenings, the winter employment of the people in cutting off the forests, sledding timber and wood, making pipe staves and barrel hoops, and most interesting of all, the institution of the old-fashioned shoemakers' shops, of which nearly every farm had one a century ago. Women in those days engaged in spinning and weaving. The holidays were referred to—Thanksgiving, Christmas and New Year's, and the winter pleasures, such as sleighrides, dancing, spinning and quilting parties, and games, shuffle-

board, coasting, skating, trapping, gunning, fishing, singing schools and girls' samplers. He also spoke of the old modes of travel, snow shoes, etc. Nearly all the heavy teaming was done on sleds, and he mentioned the winter of 1768–9, when the travelling was so bad that the farmers in the western part of the state could not get their grain and provisions to the coast to market. Snow remained on the roads as it fell until about a century ago. Mr. Perley then spoke of particular winters: that of 1641–2, when the Indians said they had not seen the ocean so much frozen for forty years: of 1646–7, when there was no snow to lay; of 1696–7, said to be the coldest winter since the first settlement of New England; of 1701–2, which was "turned into summer;" of 1717–18, when the snow was from ten to fifteen feet deep and the drifts twenty-five feet, many one-story houses being buried; of 1740–1, said to be the severest winter known by the settlers, Salem harbor being frozen over as early as October; of 1774–5, a wonderfully mild winter; of 1779–80, when for forty days, including March, there was no perceptible thaw, and the snow was so hard and deep that loaded teams passed over the fences in any direction, arches being dug under the snow so that men on horseback could ride under them, and which was long remembered as *the* hard winter; of 1784–5, when, as late as April 15, snow was two feet deep, and frozen hard enough to bear cattle; of 1785–6, when in the remarkable storm of Nov. 25, the snow blew into balls, one of which had rolled seventy-six feet, measuring 17½ by 22 inches; of 1794–5, when the Betsey was launched in Salem on Christmas Day, the thermometer indicating 80 degrees above zero at noon and men and boys went in swimming; of 1801–2, when the *Ulysses*, *Brutus* and *Volutia*, three Salem vessels, which sailed out of the harbor on a summer-like morning in February, were all

cast away at night on Cape Cod, in a terrible snow storm, which continued a week. He also referred to more recent seasons, and of the cold winter of 1856–7, when in one week in January was the coldest day by the thermometer ever recorded of late years, mercury in Salem 20 below zero. Travel on the railroad between Boston and Salem entirely suspended from Tuesday morning to Thursday afternoon. The recent mild winters were also alluded to. The lecturer exhibited an interesting diagram which he had prepared, showing at a glance the comparative severity and mildness of each winter from 1629 to the present time.

Monday, March 31, 1890.—Mr. George G. Russell of this city read a paper on his experiences at the Andersonville prison in 1864. He was captured at the battle of the Wilderness and was a prisoner eight months, four of which he spent in "Andersonville," then under the charge of Gen. J. H. Winder, commander of the "confederate" prisons, to whom, no doubt, were due the sufferings of the Union men in those prisons. At the close of the war General Winder died from disease contracted in one of those southern prisons.

Monday, April 7, 1890.—Mr. Robert Rayner of this city read a paper on "Means of Communication." The lecturer said that these were a criterion of the civilization of a country, and good artificial means are found where the civilization is high and good. In one hundred and fifty years great progress has been made, but only in the last half of that period has land communication become general. The ancient Romans built fine roads, views of which remain to this day. They generally made them of concrete three feet in depth. It was thought their durability was partly owing to the lime used which remained, after

being slacked, in pits for a period of three years. After the decline of the Roman empire, road-making came practically to an end, although McAdams succeeded in making some fine roads in England and elsewhere. Railroads were introduced in 1825, with George Stevens as an engineer; the speed from eleven to twelve miles an hour, with an outrider on a horse to warn the people of the approach of a train. The aim has been to cheapen transportation, and to-day it is less than one cent per mile for a ton.

In the United States, the improvements for travel began with canals; canal speed is limited and there are now few canals much used. The Ganges canal in India is the greatest, being about 1,000 miles in length. The lecturer spoke of the various projects for communication in Europe, Africa and America and gave a number of interesting facts and statistics in illustration of his subject.

Monday, May 5, 1890.—Prof. John Ritchie, jr., of Boston read a paper on "Ramie and Flax," a new industry for our New England mills. The *Salem Gazette* says, "The subject has special local interest from the fact that the process of converting it into a commercial article was originated by Mr. Charles Toppan of this city." Many samples of ramie in the form of raw material were shown and gave evidence of what might be accomplished with the stuff.

Ramie is the inner bark of a shrub and is no new material, the cloth in a crude form having been used for wrapping up mummies thousands of years ago. It was introduced into this country and England about the year 1800.

The lecturer spoke of the various difficulties in manufacturing, of removing the bark, the ungumming of the fibre and the special material for spinning. Mr. Toppan's

process ungums the fibre and renders it possible to spin it on ordinary cotton and woollen machinery, but the process of removing the bark still remains unsolved; the imported material comes prepared.

The additions to the library for the year (May, 1889, to May, 1890) have been as follows:

By Donation.

Folios,	50
Quartos,	173
Octavos,	930
Twelvemos,	665
Sixteenmos,	209
Twenty-fourmos,	84
Total of bound volumes,	2,111
Pamphlets and serials,	9,120
Total of donations,	11,231

By Exchange.

Folios,	72
Quartos,	31
Octavos,	212
Twelvemos,	9
Sixteenmos,	5
Twenty-fourmos,	1
Total of bound volumes,	330
Pamphlets and serials,	3,510
Total of exchanges,	3,840

By Purchase.

Folios,	3
Quartos,	2
Octavos,	71
Twelvemos,	18
Sixteenmos,	5
Total of bound volumes,	99
Pamphlets and serials,	776
Total of purchases,	875
Total of donations,	11,231
Total of exchanges,	3,840
Total of purchases,	875
Total of additions,	15,946

Of the total number of pamphlets and serials, 3,787 were pamphlets and 9,619 were serials.

The donations to the library for the year have been received from two hundred and seven individuals and seventy-five societies and governmental departments. The exchanges from eight individuals and one hundred and seventy-eight societies and incorporated institutions, of which ninety-four are foreign; also from editors and publishers.

Among the donations may be mentioned an addition to the botanical section of nearly 100 volumes, from Mr. John Robinson; about 600 volumes distributed among the various departments, from Mr. T. F. Hunt; the frequent gifts of Dr. Samuel A. Green of Boston; and the congressional documents regularly received from the Department of the Interior.

The librarian desires to call attention again to a subject which was mentioned in his last annual report, namely, the marking out of special lines of work for the Public Library and the Essex Institute, and in a lesser degree for the Salem Athenæum, and the Peabody Academy of Science. A few months since a meeting was held at the Public Library, at which were present representatives of all the societies mentioned and a unanimous agreement was arrived at, that each should as far as possible mark out a special line of its own in reference to the purchase of expensive books so that unnecessary duplication would be avoided. To the Public Library should be left the purchase of books on general literature as fiction, biography, travels, etc., and those on the industrial and mechanic arts; to the Institute, local history, genealogy, sociology, the collection of bound volumes of newspapers and other subjects within the line of its special work and, together with the Peabody Academy of Science, the scientific works largely obtained by

exchange; while the Athenæum which is less public in its character than the others, not confining itself to any special line, except perhaps its foreign scientific publications, would gain by not being obliged to duplicate the costly books to be found in the other libraries. It was also agreed by the conference, that the librarian of the Public Library should be authorized to issue a card addressed to the librarian of either of the other libraries which would entitle the holder to consult any work of reference on the shelves of those institutions. The benefit to be derived from such an arrangement will grow more and more apparent as the years go by. It is already becoming a serious problem how to properly dispose of the growing accumulation of books especially in our larger cities where space means money and sometimes a good deal of money. No library, not even the largest, can expect to be complete enough to meet the wants of all classes. But if the different libraries will work in unison each striving to make as complete as possible its own specialties much greater and better results will be attained. In this connection it would be well if the donors of books to the various libraries would understand, that unless there were some request to the contrary, their donations, to whichever library sent, would be distributed among the other libraries in accordance with this plan of specialization.

It is hoped that the coming year may see some further progress made towards preparing for a catalogue of the library. During the past year considerable work has been done in arranging and classifying the books in the different rooms and when this is completed, a card catalogue of each room should be prepared, as a beginning for a complete catalogue of the whole library.

The attendance at the rooms of the library has increased during the past year and the librarian hopes that the time

is not far distant when the funds of the Institute will allow it to follow the good example of the Public Library and Peabody Academy of Science and open its rooms to the public on the afternoons of Sunday and during the winter evenings.

CHAS. S. OSGOOD,
Librarian.

Donations or exchanges have been received from the following sources:

	Vols.	Pam.
Adelaide, Royal Society of New South Wales,	1	
Albany, New York State Library,	1	
Almy, James F.,	18	1
Alnwick, Eng., Berwickshire Naturalists' Club,		1
American Association for the Advancement of Science,	1	
Ames, George L.,		1
Amherst College,		1
Amherst, Massachusetts Agricultural College,		7
Amherst, Massachusetts Agricultural Experiment Station,	3	30
Amiens, Société Linnéenne du Nord de la France,	1	12
Anderson, Mrs. John M., Newspapers,		
Andover Theological Seminary,		1
Andrews, Charles H.,	44	136
Andrews, John P., Newspapers,	1	39
Andrews, Samuel P.,	1	35
Andrews, William P.,		23
Appleton, Francis H., Peabody,	1	
Appleton, William S., Boston,		3
Archer, Augustus J.,	8	
Arey, Mrs. Charles,	1	
Arey, Rev. Charles,	39	
Arvedson, George,	2	19
Association of Medical Officers of American Institutions for idiotic and feeble-minded persons,		1
Atherton, George W., State College, Pa.,	1	
Atwood, F. S.,	1	
Averill, James W.,	1	
Baltimore, Maryland Historical Society,	2	
Baltimore, Md., Johns Hopkins University,		9

Baltimore, Md., Peabody Institute,		1
Banvard, Mrs. J., Neponset,		2
Basel, Naturforschende Gesellschaft,		1
Batavia, K. N. Vereeniging in Nederlandsch Indië,	1	
Belfast, Naturalists' Field Club,		2
Bemis, Miss Caroline E., Newspapers,		
Bergens Museum,		1
Berkeley, University of California,	1	5
Berlin, Gesellschaft der Naturforschende Freunde,	1	
Berlin, Verein zur Beförderung des Gartenbaues,		24
Bern, Naturforschende Gesellschaft,		1
Bologna, R. Accademia delle Scienze,	1	1
Bonn, Naturhistorischer Verein der Preussischen Rheinlande u. Westphalens,		2
Bordeaux, Société Linnéenne,		1
Boston, American Academy of Arts and Sciences,		1
Boston, American Congregational Association,		2
Boston, Appalachian Mountain Club,		1
Boston Board of Health,		14
Boston, Church Home for Orphan and Destitute Children,		1
Boston, City of,	5	
Boston City Hospital,		1
Boston, Massachusetts General Hospital,		1
Boston, Massachusetts Historical Society,	2	1
Boston, Massachusetts Horticultural Society,		3
Boston, Massachusetts Humane Society,		1
Boston, Massachusetts Medical Society,		1
Boston, Massachusetts School for the Feeble-minded,		1
Boston, National Association of Wool Manufacturers,		4
Boston, New England Historic Genealogical Society, Newspapers,	113	212
Boston Public Library,	2	2
Boston Society of Natural History,		8
Bowditch, Henry I., Boston,		1
Bowker, George and Charles,	3	
Boynton, John F., Syracuse, N. Y.,	1	2
Bremen, Naturwissenschaftlicher Verein,		1
Bristol (Eng.) Naturalists' Society,		2
Brooklyn (N. Y.) Library,		1
Brooklyn, N. Y., Pratt Institute,		1
Brooks, Miss E. M. R.,	1	
Brooks, Henry M., Newspapers,	4	7
Brooks, Mrs. Henry M., Newspapers,	4	221

Brooks, I. H., Roxbury,		1
Brooks, Miss Margarette W.		5
Brown, Mrs. Henry A.,	2	
Browne, Edward C.,	35	508
Brownell, T. Frank, New York, N. Y.,	7	21
Brünn, Naturforschender Verein,		2
Brunswick, Me., Bowdoin College,		1
Bruxelles, Académie Royale,	6	
Bruxelles, Société Belge de Microscopie,		8
Bruxelles, Société Entomologique,	1	
Bruxelles, Société Malacologique,	1	12
Buenos Aires, Sociedad Cientifica Argentina,		9
Buffalo (N. Y.) Historical Society,		1
Burnham, J. H., Bloomington, Ill.,		2
Caen, Académie des Sciences, Arts et Belles Lettres	1	
Calcutta, Geological Survey of India,		4
Calcutta, Indian Museum,		2
Caldwell, Rev. Samuel L., Providence, R. I.,		1
Callendar, Hugh L., London, Eng.,		3
Cambridge, Harvard University,		4
Cambridge, Museum of Comparative Zoölogy,	1	11
Canada Royal Society,	1	
Casey, James C.,	1	
Cassel, Verein für Naturkunde,		2
Chadwick, John C., Newspapers,	9	4
Chamberlain, James,	23	215
Chamberlain, Estate of the late Samuel,	59	145
Champaign, Illinois State Laboratory of Natural History,		3
Chapel Hill, N. C., Elisha Mitchell Scientific Society,		2
Chapel Hill, University of North Carolina,		1
Chase, Henry A.,	4	1
Chever, Edward E., San Francisco, Cal., Newspaper,		
Chicago (Ill.) Historical Society,	1	
Chicago, Ill. Newberry Library,		1
Chicago (Ill.) Public Library,		12
Chicago, Rock Island and Pacific Railway Co.,		1
Christiana, Videnskabs Selskabs,		14
Cincinnati, Historical and Philosophical Society of Ohio,		1
Cincinnati, Ohio Mechanics' Institute,		1
Cincinnati (O.) Public Library,		2
Cincinnati (O.) Society of Natural History,		4
Clarke, Mrs. N. A.,	29	76
Cleveland, Miss Lucy H.,		14
Cleveland, Mrs. William S.,	21	

Cleveland, O., Western Reserve Historical Society	1	
Cogswell, William		3
Columbus, Ohio Agricultural Experiment Station		2
Conant, W. P., Charleston, S. C., Newspapers.		
Cooke, Mrs. H. Rudi, New York, N. Y.	1	
Cooke, James P., Cambridge		1
Copenhague, Académie Royale		1
Copenhague, Société Royale des Antiquaires du Nord		3
Cordoba, Academia Nacional de Ciencias		1
Cox, Francis		46
Culin, Stewart, Philadelphia, Pa.		1
Curwen, George R.	6	21
Curwen, James B., Newspapers.		39
Cutter, A. E., Charlestown		1
Dakota, Department of Immigration and Statistics		2
Dana, James D., New Haven, Ct.		1
Daniels, Mrs. C. E., Newspapers.		
Danzig, Naturforschende Gesellschaft		1
Darmstadt, Verein für Erdkunde		2
Deerfield, Pocumtuck Valley Memorial Association	1	
Detroit, Mich., Public Library		1
Dodge, James H., Boston	1	
Dorsey, George W. E., Washington, D. C.		1
Dresden, Naturwissenschaftliche Gesellschaft "Isis"		2
Dresden, Verein für Erdkunde		1
Dublin, Royal Irish Academy	1	10
Dublin, Royal Society		8
Dues, Henry E., Charlestown		1
Endicott, Charles	1	1
Erlangen, Physikalisch-Medicinische Gesellschaft		1
Essex, Eng., Field Club		5
Exeter, N. H., Phillips Academy		1
Falmouth, Eng., Royal Cornwall Polytechnic Society	1	
Farmer, Miss Sarah J., Eliot, Me.		1
Firenze, Biblioteca Nazionale Centrale		35
Firenze, R. Istituto di Studi Superiori		4
Flint, Albert S., Washington, D. C.		1
Foote, Caleb	1	
Foote, Mrs. Henry W., Boston		1
Frankfurt-a-M., Senckenbergische Naturforschende Gesellschaft	1	1
Freiburg, Naturforschende Gesellschaft		6
Fuller, Miss Hennetta F.	2	
Gardner, Miss Elizabeth B.		3

Gardner, Mrs. Henry, ... Newspapers,	12	41
Genève, Institut National Genévois, ...	2	
Genève, Société de Physique et d' Histoire Naturelle, .		1
Giessen, Oberhessische Gesellschaft für Natur u. Heilkunde, ...		1
Gilbert, Mrs. S. D., ...	43	65
Gillis, James A., Winchendon, . . Newspapers,		
Goodrich, Mrs. Almira T., Portsmouth, N. H., Newspapers,		
Göttingen, K. Gesellschaft der Wissenschaften, . .	1	
Gould, John H., Topsfield, ...		2
Gove, William H., ...	1	
Green, Samuel A., Boston, ...	111	657
Güstrow, Verein der Freunde der Naturgeschichte, .	1	
Hagerty, Frank H., Aberdeen, S. D., ...	1	
Halifax, N. S., Nova Scotian Institute of Natural Science, ...		3
Halle, K. Leop.-Carolinische Deutsche Akademie der Naturforscher, ...	1	2
Hamburg, Naturwissenschaftlicher Verein, . . .		1
Hammond, Joseph, ...	18	5
Harlem, Société Hollandaise des Sciences, . . .		4
Harris, Miss R. A., ...		3
Hart, Thomas N., Boston, ...		2
Hartford, Connecticut Historical Society, . . .	1	
Hartford, Ct., Trinity College, ...		3
Hassam, John T., Boston, ...	1	
Hazard, Mrs. Thomas G., Narragansett Pier, R. I., .	1	
Henry, Trustees of the late James, Dublin, . . .		4
Hill, Robert E., ...		2
Hitchcock, Edward, Amherst, ...		1
Hobart, Government of Tasmania, ...	2	
Hobart, Royal Society of Tasmania, ...		1
Holden, N. J., ... Newspapers,		
Hopkins, Trustees of Charity of Edward, . . .	1	
Horton, N. A., & Son, ...	168	402
Hotchkiss, Miss Susan V., New Haven, Ct., Newspapers,		
Hunt, T. F., ...	598	163
Huntington, C. P., New York, N. Y., ...		2
Huot, Lucien, St. Johns, P. Q., ...		1
Iowa City, Ia., State Historical Society, ...		4
Iowa City, Ia., State University of Iowa, . . .		1
Ives, Henry P., ...		12
Keyes, Charles R., Baltimore, Md., ...		3
Kimball, Mrs. James, ... Newspapers,	6	26

Kimball, James P., Washington, D. C.,	1	
Kingman, Bradford, Brookline,		1
Kingsley, J. S., Lincoln, Neb.,		4
Kjöbenhavn, Botaniske Forening,		1
Kjöbenhavn, K. D. Videnskabernes Selskabs,		2
Lamson, Frederick,		17
Lander, Henry B.,	1	
Lansing, Michigan State Library,	15	17
Lausanne, Société Vaudoise des Sciences Naturelles,		3
Lee, Francis H., Newspapers,		375
Lee, Mrs. Francis H., Newspapers,		123
Leech, Edward O., Washington, D. C.,	1	
Leeds, Philosophical and Literary Society,		1
Leiden, Nederlandsche Entomologische Vereeniging,		7
LeMans, Société d'Agriculture, Sciences et Arts de la Sarthe,		1
Lesley, Edward, Boston,		10
Lexington Historical Society,	1	
Lieber, G. Norman, Washington, D. C.,		1
London, Royal Society,		11
Lovett, William H., Beverly,		2
Lowell, Old Residents' Historical Association,		1
Lyon, Académie des Sciences, Belles-Lettres et Arts,	5	
Lyon, Société d'Agriculture, d'Histoire Naturelles et des Arts Utiles,	3	3
Lyon, Société Linnéenne,	3	
McDaniel, Rev. B. F., San Diego, Cal.,	1	9
Mackintosh, Newton, Newspapers,	2	
Madison, Wis., State Historical Society,		2
Madrid Observatorio,	3	
Madrid, Sociedad Española de Historia Natural,		3
Manchester, Eng., Literary and Philosophical Society,	1	
Mannheim, Verein für Naturkunde,		1
Manning, R. C.,		571
Marburg, Gesellschaft zur Beförderung der gesammten Naturwissenschaften,		
Marietta, O., Commissioners of national centennial celebration of settlement of,	1	
Massachusetts Club,		1
Massachusetts, Secretary of the Commonwealth of,	6	1
Massachusetts State Board of Health,	1	53
Meek, Henry M.,	18	
Merrill, William, jr., West Newbury,	1	45
Michigan Agricultural College,		20

Middletown, Ct., Wesleyan University, ...		1
Milwaukee, Wis., Natural History Society, . . .		3
Mitchell, W. E., New York, N. Y., ...		3
Montgomery, James Mortimer, New York, N. Y., . .		1
Montreal, Natural History Society, ...		4
Morse, Miss Edith O., ...	1	
Morse, Edward S., ... Newspapers,	28	231
Morse, John G., ...		1
Moseley, Edward A., Washington, D. C., . . .	1	
München, K. B. Akademie der Wissenschaften, . .		11
Napoli, Accademia delle Scienze Fisiche e Matematiche,	1	12
Nevins, W. S., ...	6	26
Newark (N. J.) Free Public Library, ...	1	4
Newark, New Jersey Historical Society, . . .	23	36
New Haven, Ct., Yale University, ...		5
New London (Ct.) County Historical Society, . .		1
Newport, R. I., Redwood Library, ...		1
Newton, R. Bullen, London, Eng., ...		1
New York Central & Hudson River R. R. Co., . .		1
New York Forest Commission, ...	1	
New York, N. Y., Academy of Sciences, ...		8
New York, N. Y., American Geographical Society, .		5
New York, N. Y., American Museum of Natural History,		21
New York, N. Y., Central Park Menagerie, . . .		1
New York, N. Y., Engineering News Publishing Co., .	1	1
New York (N. Y.) Genealogical and Biographical Society,		4
New York (N. Y.) Historical Society, ...	2	2
New York, N. Y., Huguenot Society of America, . .	1	1
New York, N. Y., Lenox Library, ...		1
New York, N. Y., Mercantile Library Association, .	17	8
New York (N. Y.) Microscopical Society, . . .		4
Nichols, Andrew, jr., Danvers, . . Newspapers,		6
Nichols, John H., ...		17
Nichols, Mrs. R. Anne, Roxbury, ...	2	
Nichols, Mrs. Sarah L., ...	20	
Nurnberg, Naturhistorische Gesellschaft, . . .		1
O'Hanlon, Rev. John C., Dublin, ...	1	
Ohio Meteorological Bureau, ...		12
Ottawa, Geological and Natural History Survey of Canada, ... Maps,	3	1
Packard, A. S., Providence, R. I., ...	1	
Page, Miss Anne L., Danvers, ...		1
Paine, Nathaniel, Worcester, ...		2
Palermo, R. Accademia di Scienze, Lettere e Belle Arti,	1	

Palfray, Charles W.,	Newspapers,		1925
Paris, Société d'Acclimatation,			26
Paris, Société d'Anthropologie,			4
Paris, Société des Etudes Historiques,		1	
Patch, Ira J.,		32	66
Peabody Institute, Peabody,			1
Pease, George W.,		86	10
Peet, Rev. S. D., Mendon, Ill.,			5
Peirce, Mrs. B. O., Beverly,	Maps,	18	1
Peirce, Estate of the late Nathan,	Newspapers, Maps,	22	23
Peirson, Mrs. E. B.		1	3
Perkins, Henry A., Philadelphia, Pa.,			1
Perley, Edward L.,			362
Perley, M. V. B., Ipswich,			1
Perley, Sidney,			2
Perry, Rev. Wm. S., Davenport, Ia.,			1
Philadelphia, Pa., Academy of Natural Sciences,			3
Philadelphia, Pa., American Catholic Historical Society,		2	
Philadelphia, Pa., American Philosophical Society,			5
Philadelphia, Pa., Library Company,			2
Philadelphia, Pennsylvania Academy of Fine Arts,			3
Philadelphia, Pennsylvania Historical Society,			3
Philadelphia, Pa., Wagner Free Institute of Science,			1
Philadelphia, Pa., Zoölogical Society,			2
Phillips, Henry, jr., Philadelphia, Pa.,			1
Phillips, Stephen H.,	Newspapers,		13
Plumer, Miss Mary N.,	Newspapers,		5
Plymouth County Bar Association,		1	
Poole, W. F., Chicago, Ill.,			2
Poore, Alfred,			1
Pope, F. L., Elizabeth, N. J.,		1	1
Porter, Rev. Aaron,	Newspapers,		
Portland, Maine Historical Society,		1	2
Portland (Me.) Society of Natural History,			14
Providence, R. I., Brown University,			1
Providence, Rhode Island Historical Society,			4
Providence, R. I., Narragansett Historical Publishing Company,			3
Providence (R. I.) Public Library,			1
Putnam, F. W., Cambridge,		1	2
Rantoul, Robert S.,		6	71
Raymond, Samuel, Brooklyn, N. Y.,		1	
Rayner, Robert,	Newspapers,		
Reeves, J. T., Appleton, Wis.,		1	

Rice, Rev. C. B., Danvers, ...		1
Richardson, F. P., ... Newspapers,		
Richmond, Virginia Historical Society, ...	2	
Riga, Naturforscher Verein, ...		4
Roads, Samuel, jr., Marblehead, ...		1
Robbins, Jesse, ...	2	
Robinson, John, ... Newspapers,	94	13
Roma, Biblioteca Nazionale Centrale Vittorio Emanuele,		4
Ropes, Mrs. Charles A., ... Newspapers,	26	165
Ropes, Willis H., ...	1	1
Russell, John A., San Francisco, Cal., ...	1	
Russell, Estate of the late Miss Sarah O., ...	7	107
Sacramento, California State Library, ...	1	
St. Gallen, Naturwissenschaftliche Gesellschaft, . .		1
St. Johns, N. B., Natural History Society, ...		1
St. Louis (Mo.) Public Library, ...		1
St. Paul, Minnesota Academy of Natural Sciences, .		1
St. Pétersbourg, Académie Impériale des Sciences, .		20
St. Petersburg, Imperial botanical Garden, ...		1
Salem, Peabody Academy of Science, ...	23	795
Salem Press, ...	1	3
Salem Public Library, ... Newspapers,	2	39
San Francisco, California Academy of Sciences, . .	23	9
San Francisco (Cal.) Mercantile Library Association, .		1
San Francisco, California State Mining Bureau, . .	1	
San Francisco (Cal.) Free Public Library, ...		1
San Francisco, Cal., Southern Pacific Co., ...		1
Saunders, Miss Mabel B., ...	1	
Shanghai, China Branch of the Royal Asiatic Society, .		2
Sheldon, George, Deerfield, ...		1
Silsbee, George S., ...	35	
Silsbee, Mrs. John H., ... Newspapers,		32
Silsbee, Rev. William, ...		2
Simonds, William H., jr., ...		2
Smith, Miss Alice B., Mound City, Ill., . Newspapers,		
Smith, George Plumer, Philadelphia, Pa., Newspapers,	1	1
Smith, Miss Mary Bartlett, Wellesley, ...		1
South Boston, Perkins Institution and Massachusetts School for the Blind, ...	1	
Spinney, W. F., Shanghai, China, ...		1
Springfield, City Library Association, ...		1
Springfield, Mo., Drury College, ...		1
Stephens, B. A., Los Angeles, Cal., ...		1
Stettin, Entomologischer Verein, ...	1	

Stickney, George A. D.,		5	
Stickney, M. A.,			1
Stimpson, T. M.,	Newspapers,		
Stockholm, Royal Academy of Science,		23	7
Stockholm, Société Entomologique,			1
Stone, Arthur R.,		21	1
Stone, B. W.,	Newspapers,		
Stone, Mrs. Ellen A., East Lexington,	Newspapers,	8	26
Stone, Mrs. Lucy, Boston,	Newspapers,		
Stone, Robert,	Newspapers,		31
Stone, William,	Newspapers,	2	7
Storer, Horatio R., Newport, R. I.,			2
Sydney, Linnean Society of New South Wales,			2
Sydney, Royal Society of New South Wales,		1	2
Taunton, Old Colony Historical Society,			1
Taunton, Eng., Somersetshire Archæological and Natural History Society,		1	
Tennessee State Board of Health,			11
Thayer, Rev. G. A., Cincinnati, O.,		4	
Thayer, Oliver,		1	2
Thwing, Walter E., Boston,		1	
Tilley, R. H., Newport, R. I.,			1
Tilton, John P.,			5
Topeka, Kan., Academy of Sciences,		1	
Topeka, Kansas Historical Society,		13	27
Topeka, Kan., Washburn College Laboratory of Natural History,			2
Topinard, P., Paris,			1
Toronto, Canadian Institute,			4
Towne, Mrs. Mary W., New Rochelle, N. Y.,		46	7
Trenton, N. J., Microscope Publishing Co.,			12
Trenton (N. J.) Natural History Society,			1
Tromso Museum,			2
Tuckerman, Frederick, Amherst,			1
Turner, J. Horsfall, Idel, Bradford, Eng.,			4
Turner, Ross,		1	24
Tuttle, Julius H., Boston,			1
Unknown,		38	23
Upton, George,		1	
Urban, Theodore L., Columbia, Pa.,			1
U. S. Bureau of Education,		3	12
U. S. Bureau of Ethnology,		2	
U. S. Chief of Engineers,		5	
U. S. Chief of Ordnance,		1	

U. S. Chief Signal Officer,		6	1
U. S. Coast and Geodetic Survey,		1	9
U. S. Commissioner of Pensions,			1
U. S. Comptroller of the Currency,		1	
U. S. Department of Agriculture,		1	
U. S. Department of the Interior,		103	2
U. S. Department of State,		3	13
U. S. Fish Commission,		2	
U. S. Geological Survey,		2	6
U. S. Life Saving Station,		1	
U. S. National Museum,		2	10
U. S. Naval Observatory,		1	
U. S. Patent Office,		2	55
U. S. Quartermaster General,		1	
U. S. Surgeon General's Office,		1	
U. S. Treasury Department,		1	
U. S. War Department,		10	
Veazey, W. G., Washington, D. C.,		1	
Voorhees, Rev. L. B.,			28
Walker, Benjamin, Lowell,		1	
Walker, Joseph B., Concord, N. H.,		1	
Washington, D. C., Anthropological Society,			5
Washington, D. C., Legacion de la República de Costa Rica,			4
Waters, David P.,		52	498
Waters, H. F.,		1	27
Waters, J. Linton,			1
Waterville, Me., Colby University,			8
Watson, Miss C. A., North Andover,			5
Watson, S. M., Portland, Me.,			2
Welch, W. L.,	Newspapers,	35	30
Welsh, Charles H.,		1	
West Newbury Natural History Club,			25
Wheatland, Miss Elizabeth,			7
Wheildon, William W., Concord,			2
Whipple, George M.,	Newspapers,	20	33
Whipple, Prescott,	Newspapers,		91
White, A. P.,			2
Whitehouse, Cope, New York, N. Y.,			1
Whitmore, William H., Boston,		1	
Whitney, Mrs. Henry M., North Andover,	Newspapers,		3
Wien, K. K. Zoologisch-Botanische Gesellschaft,			4
Wiesbaden, Nassauischer Verein für Naturkunde,			1

Wilkes-Barré, Pa., Wyoming Historical and Geological Society,		1
Williams, J. Fletcher, St. Paul, Minn.,		1
Willson, Rev. E. B.,		76
Winnipeg, Historical and Scientific Society of Manitoba,		5
Winsor, Justin, Cambridge,		33
Winthrop, Robert C., Boston,		7
Woodbury, Rev. Augustus, Providence, R. I.,		1
Woods, Mrs. Kate T.,	Newspapers,	1
Worcester, American Antiquarian Society,		2
Worcester Natural History Society,		2
Worcester Society of Antiquity,		2
Wright, Frank V.,	Newspapers, 1	133
Wright, W. H. K., Plymouth, Eng.,		9
Würzburg, Physikalisch-Medicinische Gesellschaft,		2

The following have been received from editors or publishers:

American Exchange and Mart.
American Journal of Science.
American Naturalist.
Beverly Citizen.
Browne's Phonographic Monthly.
Cape Ann Advertiser.
Chicago Journal of Commerce.
Danvers Mirror.
Georgetown Advocate.
Groton Landmark.
Iowa Churchman.
Ipswich Chronicle.
Lawrence American.
Le Naturaliste Canadien.
Lyceum Herald.
Lynn Bee.
Musical Herald.
Musical Record.
Nation.
Naturalist's Leisure Hour and Monthly Bulletin.
Nature.
New England Magazine.
Old New York.
Open Court.
Our Dumb Animals.
Peabody Press.
Peabody Reporter.
Sailors' Magazine and Seamen's Friend.
Salem Gazette.
Salem News.
Salem Observer.
Salem Register.
Traveler's Record.
Voice.
West Newbury Messenger.
Zoologischer Anzeiger.

The donations to the cabinets during the year number four hundred and sixty-four from the following one hundred and twenty-five donors :—

Andrews, Moulton & Johnson.
Arvedson, George.
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Baker, Charles.
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Brooks, Miss Margarette W.
Brown, Mrs. Henry A.
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Chamberlain, James A.
Chamberlain, Samuel, Estate of.
Chandler, A. W., Hamilton.
Clark, Rev. De Witt S.
Clarke, Mrs. N. A.
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Cleveland, Miss Mary S.
Cleveland, W. S., Heirs of.
Cleveland, Mrs. W. S.
Coffee, James.
Cox, Francis.
Curwen, George R.
Curwen, James B.
Dailey, Peter.
Dennis, William D.
Dolliver, Elizur L., Marblehead.
Dolliver, Polly, Marblehead.
Edes, Henry H., Charlestown.
Estes, George W., jr.
Fessenden, Joseph.
Foote, Caleb.
Foster, E. O.
Fowler, Miss Harriet P., Danvers.
Gardner, Daniel B.
Gardner, Miss Elizabeth B.
Gardner, Mrs. Henry.
Gove, William H.
Green, Samuel A.
Gregory, James J. H., Marblehead.
Hammond, Joseph.
Harris, James.
Hawkes, Nathan M., Lynn.
Higginson, Waldo, Boston.
Hill, Benjamin D.
Hill, William M.
Hotchkiss, Miss Susan V., New Haven, Conn.
Hubon, Henry G.
Hudson, Mrs. Abby M., Roxbury.
Hunt, T. F.
Hutchinson, T. J.
Ireson, Mrs. C. K.
Johnson, Daniel H., New York.
Johnson, E. Frank.
Johnson, Samuel A.
Johnson, Thomas H.
Jones, Gardner M.
Kimball, Miss Elizabeth H.
Kimball, Mrs. Ruth P. S.
Kimball, Miss Sarah H.
Kinsman, Mrs. Wm. L.
Lamson, Frederick.
Lander, Miss Louisa.
Lee, Francis H.
Little, David Mason.
Mitchell, W. E., New York.
Morse, Edward S.
Morse, John G.
Nevins, W. S.
Nichols, John H.
Nichols, John Henry.
Northend, William D.
Oliver, H. K.

Osborne, Miss H. Frances.
Osgood, Charles.
Palfray, Charles W.
Payson, Edward H.
Peabody Academy of Science.
Peirce, Nathan, Estate of.
Philbrick, Misses Eliza and Helen.
Phillips, Mrs. Adeline G., Topsfield.
Phillips, Irving F.
Phippen, George D.
Pierce, Josiah, Washington, D. C.
Plumer, Miss Mary N.
Porter, Rev. Aaron.
Quimby, E. H., Malden.
Rantoul, R. S.
Rayner, Robert.
Rice, Rev. C. B., Danvers.
Robbins, Jesse.
Robinson, John.
Ropes, Mrs. Charles A.
Ropes, James M.
Ropes, Willis H.
Russell, Miss Sarah O., Estate of.
Russell, William.
Salem Gazette, Publishers of.
Salem Hospital, Trustees of.
Saunders, Miss Mabel B.
Saunders, Miss Mary T.
Silsbee, Mrs. John H.
Silsbee, Rev. William.
Simonds, William H., jr.
Skerry, Gideon F.
Smith, George Plumer, Philadelphia, Pa.
Smith, Miss Sarah E.
Steel, Richard C. de la, Baltimore, Md.
Stone, Mrs. Ellen A., Lexington.
Tapley, D. J., New York.
Turner, Ross.
Valentine, Miss M. P.
Waters, Henry F.
Webb, Benjamin.
Welch, William L.
Wheatland, H.
Whipple, George M.
Whipple, Mrs. George M.
Whipple, Prescott.
Whipple, Mrs. S. K., Newburyport.
Williams, Miss Mary E.
Winthrop, Robert C., jr., Boston.
Wright, Frank V.

TREASURER'S REPORT.—Receipts and expenditures of the past year (condensed from the account presented).

RECEIPTS.

For balance of last year's account,		$395 94
" conditional donation from Mrs. Sarah A. Silver,	$1,000 00	
" interest from Five Cents Savings Bank to be funded,	43 38	
		$1,043 38
" assessments of members,	$816 00	
" income of invested funds,	3,084 53	
" sale of publications,	623 04	
" amounts from other sources,	158 45	
Net income,		$4,682 02
		$6, 121 34

EXPENDITURES.

By salaries of secretary, assistant librarians and janitor,	$2,043 33	
" cost of books, periodicals and binding,	655 71	
" " " publications and printing,	1,220 23	
" " " fuel,	217 25	
" " " gas and water,	75 42	
" " " repairs,	80 85	
" " " tax on barn,	24 50	
" " " express, postage and sundries,	216 42	
" paid Salem Athenæum, portion of repairs and expenses,	166 80	
" " annuities, obligations with legacies,	710 00	
Net expenses,		$5,410 51
By amount added to manuscript fund,	$32 88	
" " " " North bridge, monument fund,	10 50	$43 38
Balance on hand,		667 45
		$6,121 34

May 19, 1890. Respectfully submitted,

GEO. D. PHIPPEN, *Treasurer.*

Examined and approved,

R. C. MANNING, *Auditor.*

INVESTMENT OF THE FUNDS.

For the Essex Institute building,	$28,370 69
" Ship Rock and land,	100 00
" purpose of income,	61,269 10
Total investment,	$89,739 79

Salem, May 17, 1890.

Examined and found to agree with the securities,

R. C. MANNING, *Auditor.*

Necrology of Members.

William G. Barton, son of Gardner and Ann (Donaldson) Barton, was born in Salem, April 4, 1851; elected a member of the Essex Institute, Jan. 1, 1872 and died in Danvers, Jan. 23, 1890.

Samuel Chamberlain, son of Samuel and Mary (Bowman) Chamberlain, was born in Salem, Jan. 20, 1799; elected a member of the Essex Institute, May 8, 1872 and died in Salem, Sept. 25, 1889.

Mrs. Nancy D. Cole, widow of Thomas Cole and daughter of Joel and Abigail Baker (Davis) Gay, was born in Roxbury, Jan. 19, 1795; elected a member of the Essex County Natural History Society in 1834 and died in Salem, Jan. 13, 1890.

Daniel P. Galloupe, son of Israel and Betsy (Ross) Galloupe, was born in Topsfield, Jan. 20, 1807; elected a member of the Essex Institute, June 11, 1852 and died in Lowell, May 3, 1890.

Henry Gardner, son of John and Mary (West) Gardner, was born in Salem, Sept. 26, 1809; elected a member of the Essex Institute, April 9, 1856 and died in Salem, Jan. 20, 1890.

Dr. Charles Haddock, son of Prof. Charles Brickett and Susan (Saunders) Haddock, was born in Hanover, N. H., July 14, 1822; elected a member of the Essex Institute, May 10, 1848 and died in Beverly, Oct. 10, 1889.

Joseph H. Hanson, son of Tobias and Susan A. (Adams) Hanson, was born in Wakefield, N. H., March 31, 1816; elected a member of the Essex Institute, July 6, 1864 and died Feb. 17, 1890.

John S. Jones, son of William and Elizabeth (Giles) Jones, was born in Salem, July 19, 1824; elected a member of the Essex Institute, Dec. 16, 1867 and died in Salem, Dec. 2, 1889.

John Kinsman, son of John Choate and Anna (Lord) Kinsman, was born in Ipswich, Sept. 3, 1810; elected a member of the Essex Institute, Feb. 8, 1865 and died in Salem, Nov. 16, 1889.

Charles Lamson, son of Asa and Rebecca (Vickery) Lamson, was born in Salem, Sept. 16, 1817; elected a member of the Essex Institute, July 6, 1864 and died in Salem, March 12, 1890.

Joseph W. Merrill, son of Nathan S. and Sally Merrill, was born in So. Hampton, N. H., Dec. 13, 1819; elected a member of the Essex Institute, Oct. 5, 1874 and died in Cambridge, Nov. 12, 1889.

Charles H. Miller, son of Samuel and Nancy (Brown) Miller, was born in Belfast, Me., Dec. 1, 1819; elected a member of the Essex Institute, March 21, 1870 and died in Washington, D. C., while on a visit there, April 16, 1890.

George P. Osgood, son of John Williams and Sarah (Prince) Osgood, was born in Salem, March 22, 1813; elected a member of the Essex Institute, May 20, 1857 and died in Salem, Nov. 2, 1889.

William Pickering, jr., son of William and Mary (Pettee) Pickering, was born in Salem, July 25, 1838; elected a member of the Essex Institute, Nov. 12, 1886 and died in Salem, July 6, 1889.

William D. Pickman, son of Dudley Leavitt and Cath-

erine (Saunders) Pickman, was born in Salem, Jan. 6, 1819; elected a member of the Essex County Natural History Society, July 9, 1845, and of the Essex Historical Society, Sept. 8, 1846 and died in Boston, Feb. 28, 1890.

Dr. Henry E. Pope, son of Eleazer and Mary (Nimblet) Pope, was born in Salem, Feb. 16, 1819; elected a member of the Essex Institute, Sept. 16, 1867 and died in Salem, March 7, 1890.

Charles C. Redmond, son of Peter and Nancy Redmond, was born in Solon, Me., April 8, 1850; elected a member of the Essex Institute, Jan. 17, 1887 and died in Salem, Sept. 15, 1889.

Charles A. Ropes, son of Benjamin and Frances (Wilkins) Ropes, was born in Salem, March 14, 1818; elected a member of the Essex Institute, March 8, 1854 and died in Salem, March 19, 1890.

Eleazer Wheelock Ripley Ropes, known as Ripley, son of Benjamin and Frances (Wilkins) Ropes, was born in Salem, Sept. 30, 1820; elected a member of the Essex Institute, March 8, 1854 and died in Brooklyn, N. Y., May 18, 1890.

Mrs. Rebecca A. Silsbee, wife of John H. Silsbee and daughter of Pickering and Rebecca (Jenks) Dodge, was born in Salem, Dec 21, 1819; elected a member of the Essex Institute, July 6, 1864 and died in Salem, April 18, 1890.

Rev. William Silsbee, son of William and Mary (Hodges) Silsbee, was born in Salem, May 17, 1813; elected a member of the Essex Historical Society, Sept. 8, 1846, and of the Essex Institute, March 29, 1848 and died in Salem, Jan. 8, 1890.

Henry D. Sullivan, son of Thomas R. and Charlotte C. (Blake) Sullivan, was born in Boston, June 20, 1841; elected a member of the Essex Institute, Jan. 16, 1888 and died in Paris, while on a journey, Aug. 29, 1889.

A more complete account of some of these members who have been conspicuous in the works of the Institute and of some who have contributed largely to those departments of science and history which are included in the province of the society, will be given in some future number of the Historical Collections.