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THE DEVELOPMENT OF CRANGON VULGARIS.

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

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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

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

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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-

[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

[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 postoral 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*.

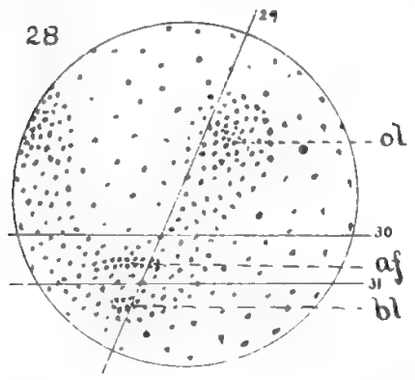
Fig. 64 is the 18th, 65 the 20th, fig. 66 the 22nd, 67 the 24th, 68 the 26th while 69 passes through the abdomen alone.

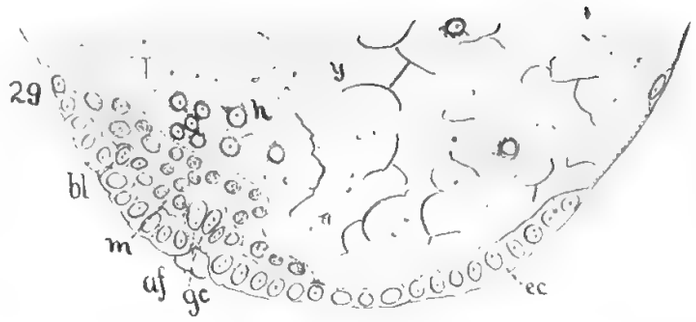
Fig. 70. An enlarged view of a liver sac at stage *H* showing the amœboid character of the entoderm cells.

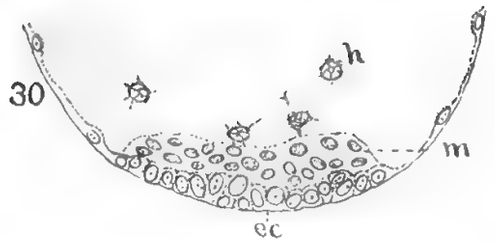
Fig. 71. A diagrammatic representation of the relations of nerves and ganglia in the brain at stage *H*.

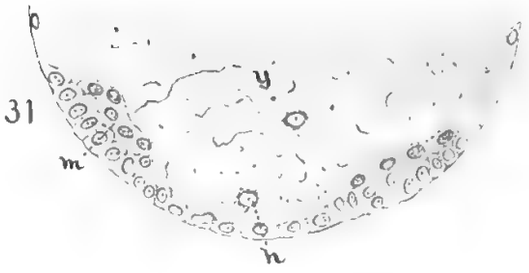
Figs. 72 and 73. Two longitudinal sections through the head and brain of a free swimming zoea of Crangon.

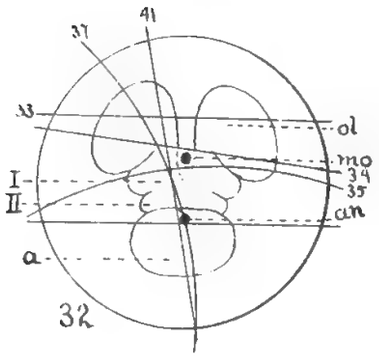
Fig. 74. Section through the base of the second antenna of a zoea showing (*eo*) the external opening to the green gland. The lumen of the gland did not appear in the section from which the drawing was made.

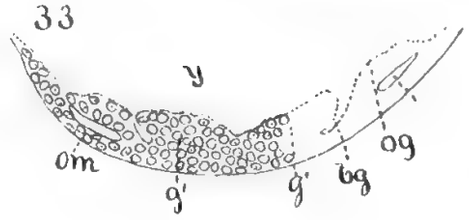


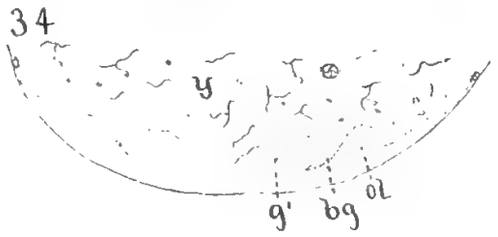


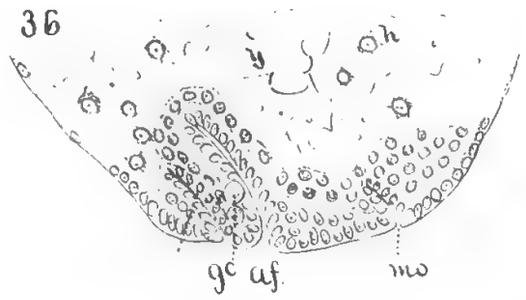


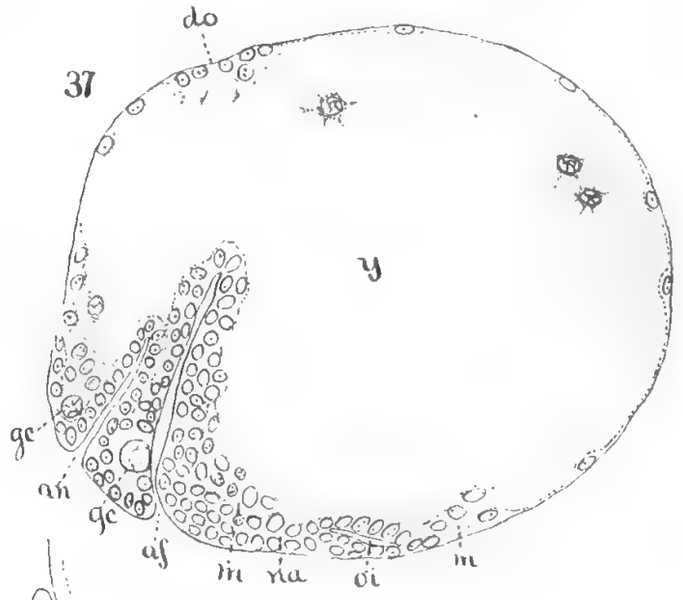


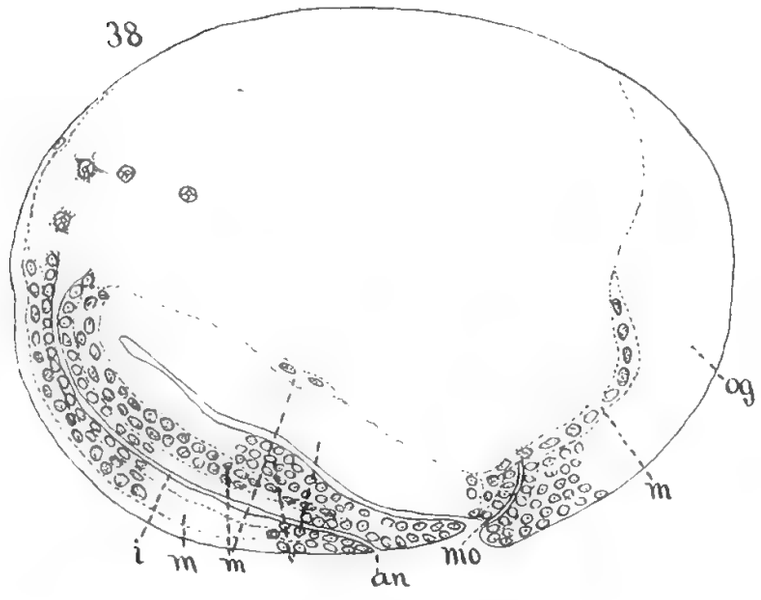


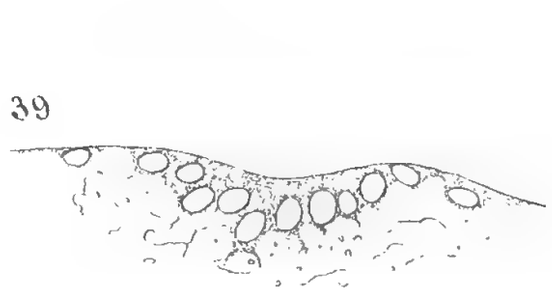


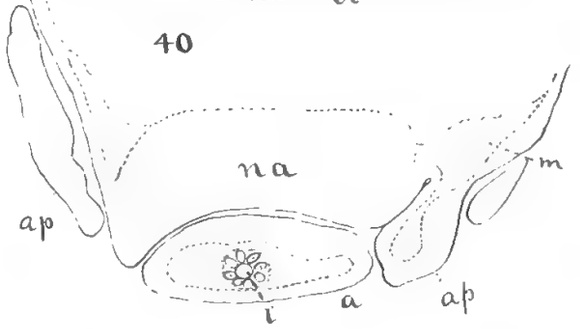


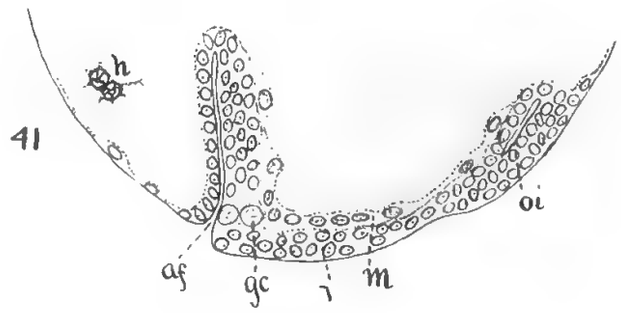


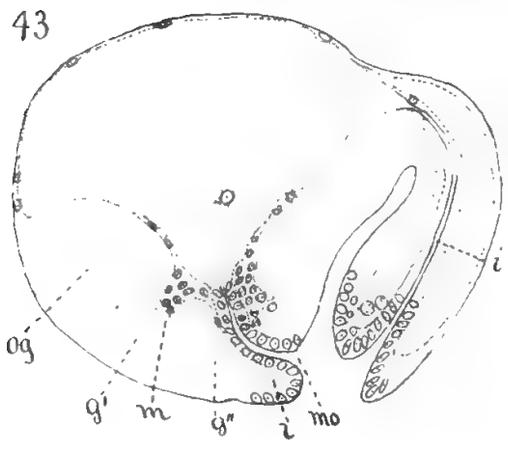


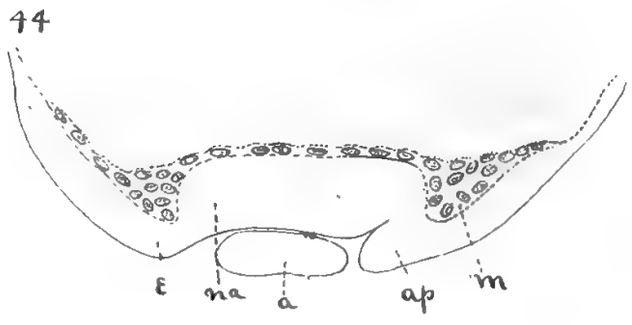


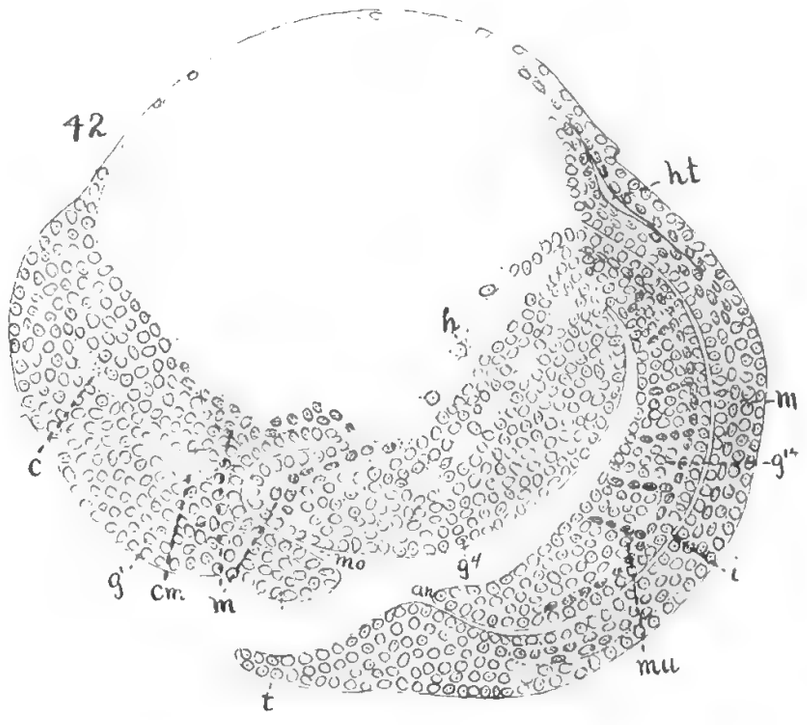












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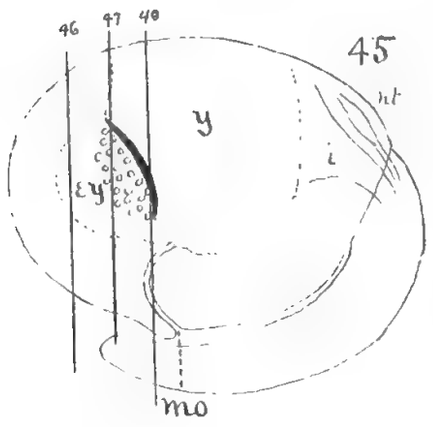

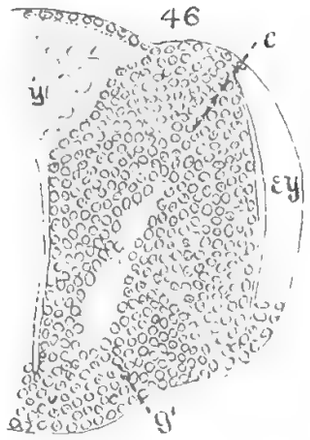

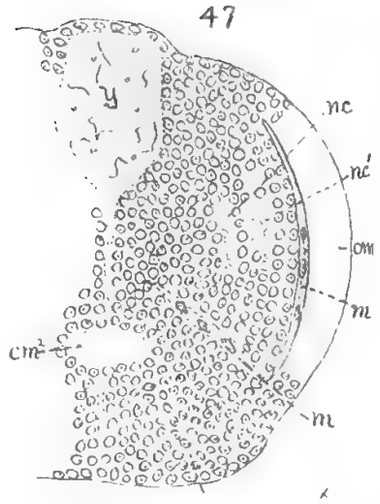

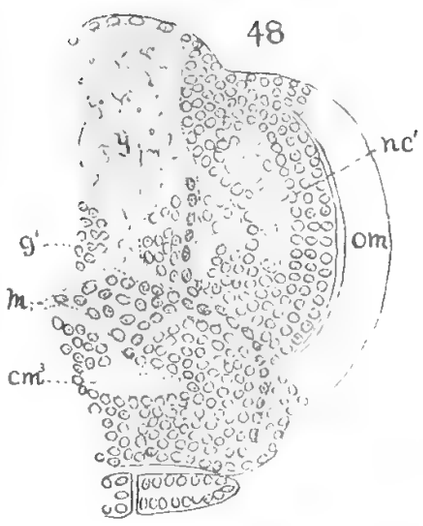

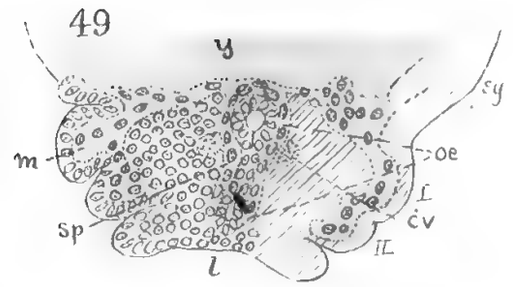

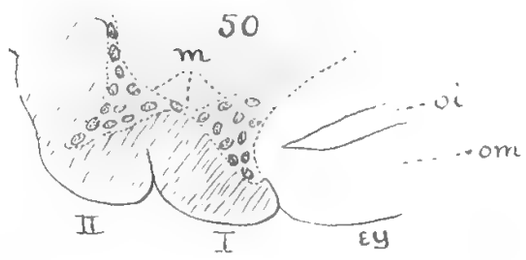

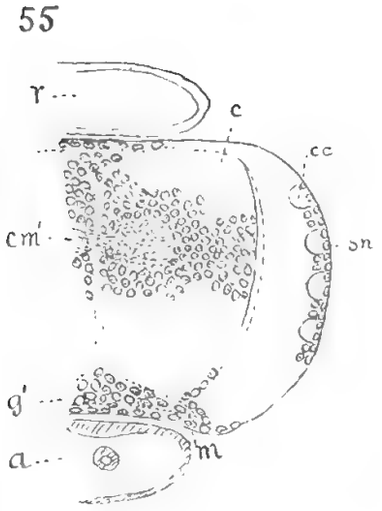

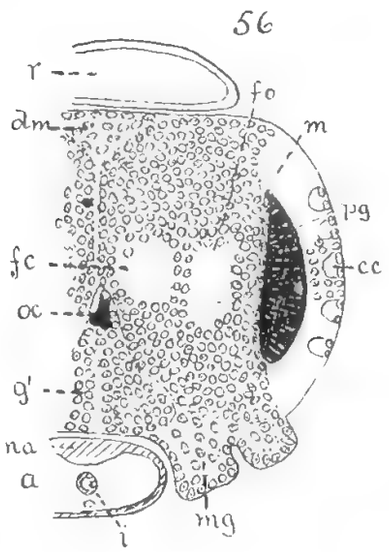

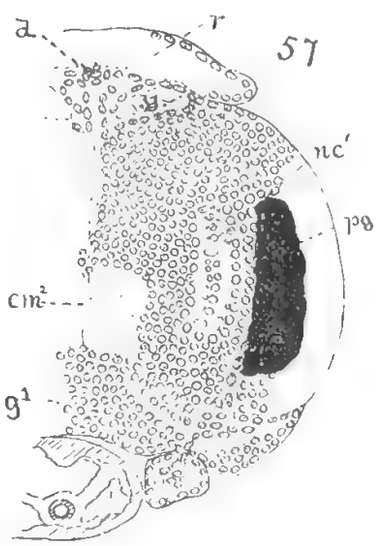

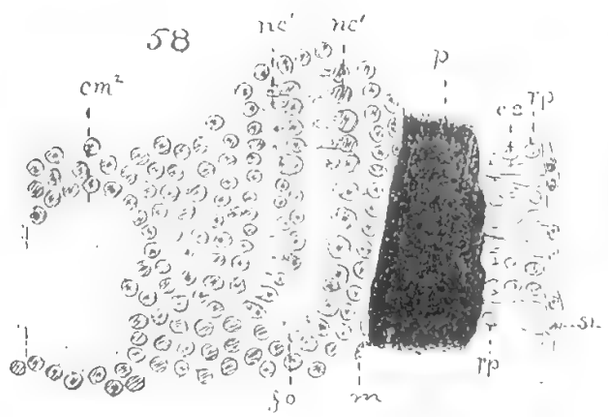

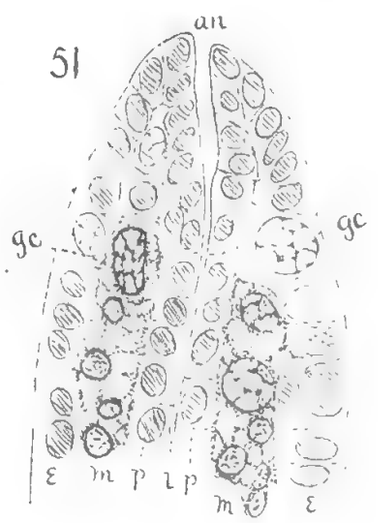

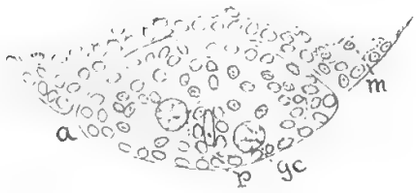

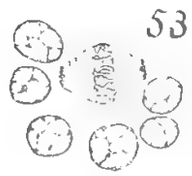

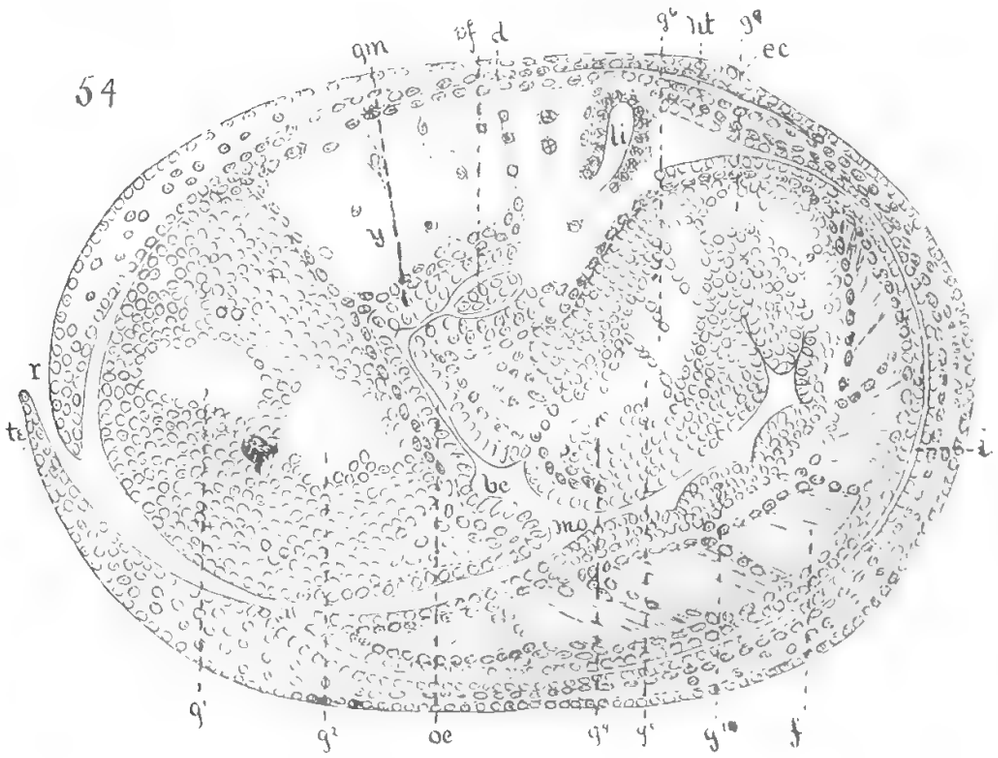

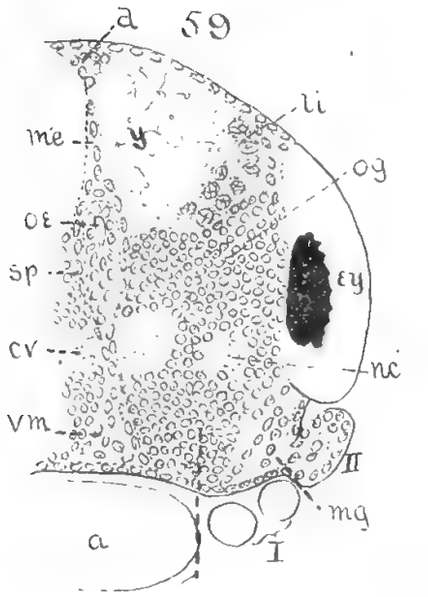

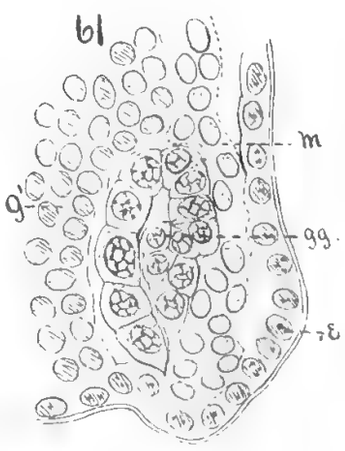

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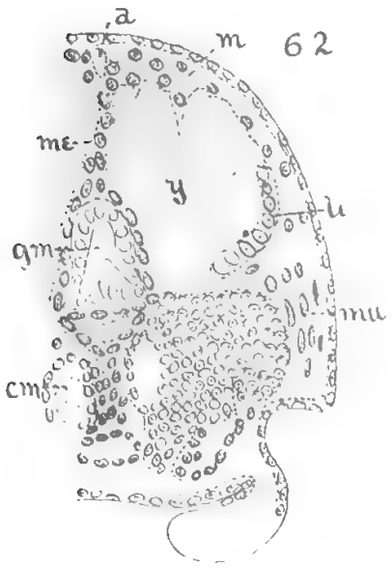

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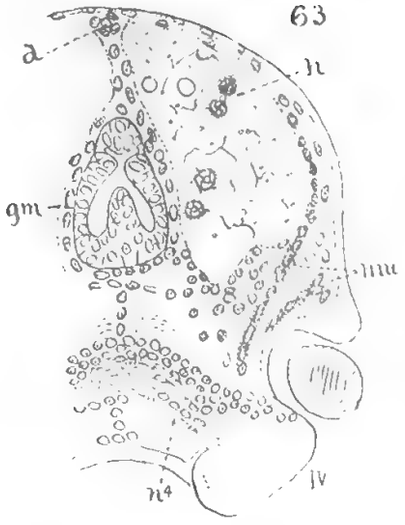

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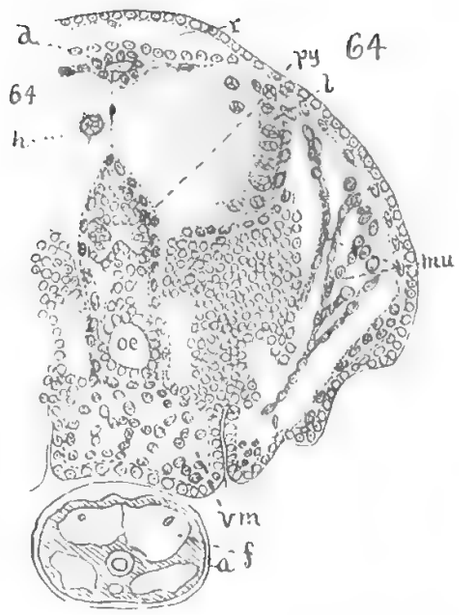

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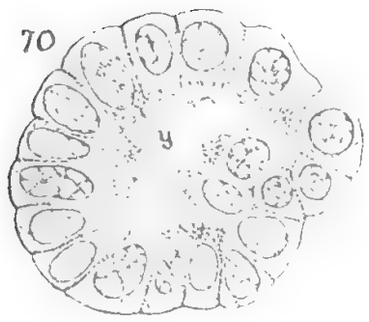

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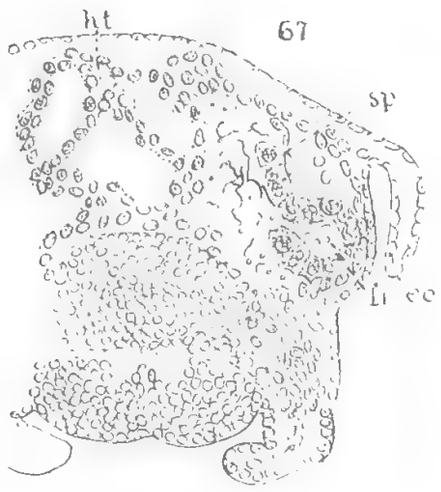

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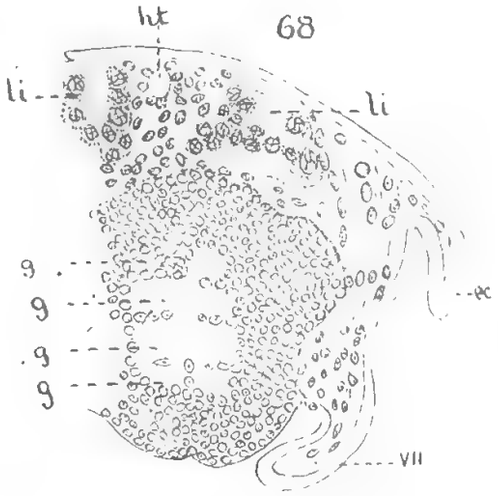

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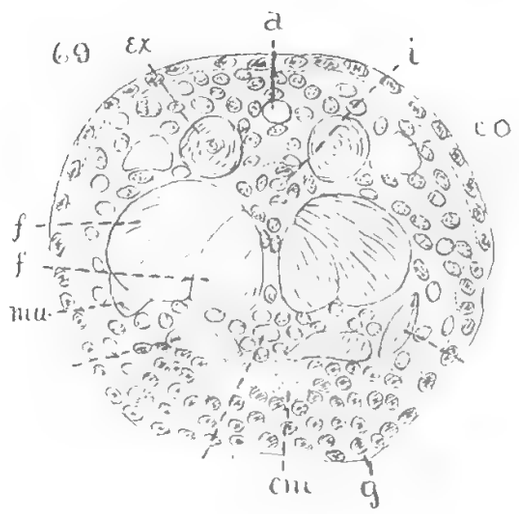

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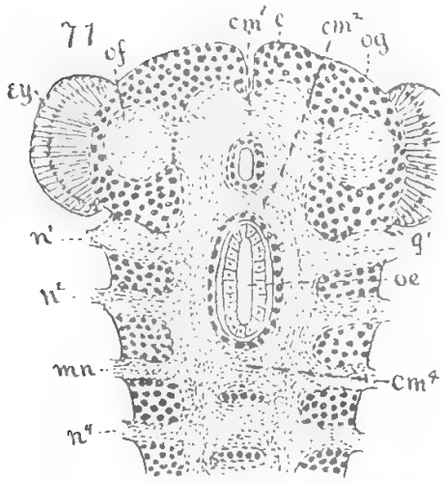

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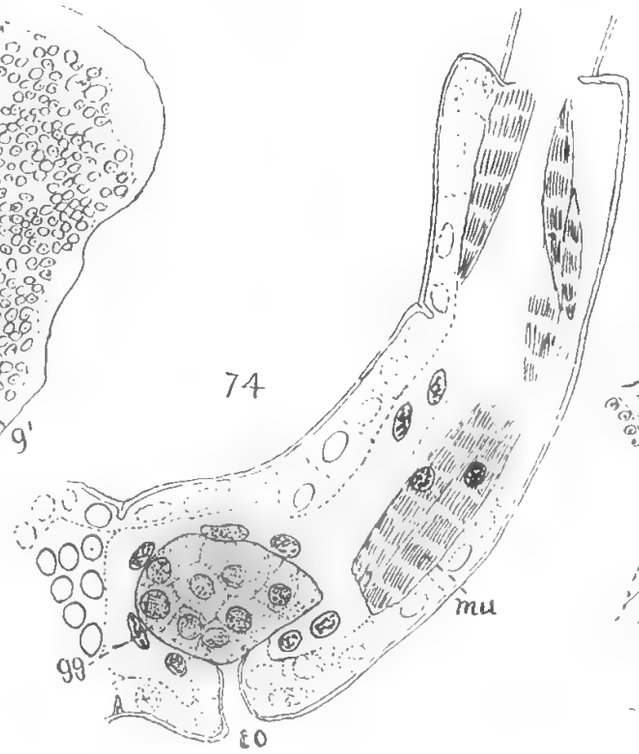

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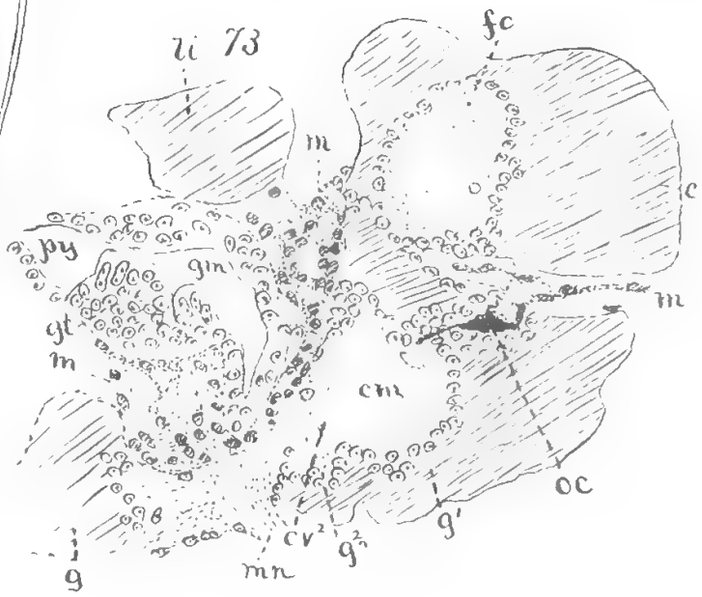

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NEW PHOSPHORESCENT ORGANS IN PORICHTHYS.

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.

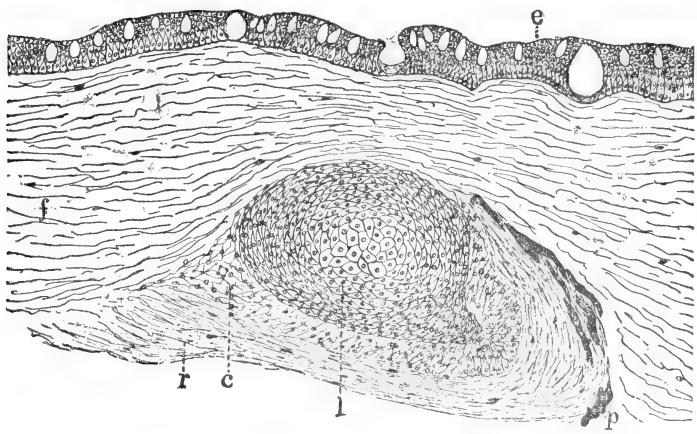
Between the postorbital and the lateral is the curved scapular row (*s*) which in some specimens bends upward toward the dorsal and is then prolonged along the back to form a second dorsal row consisting of phosphorescent organs and mucous pores arranged as in the occipital row.

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.

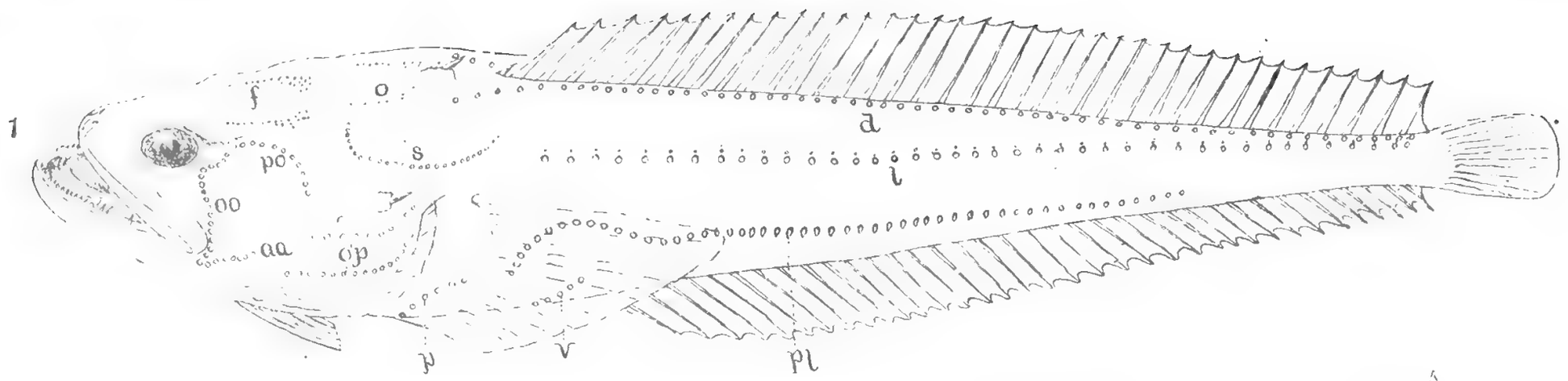
a = anal row.
aa = angular row.
c = connective tissue capsule.

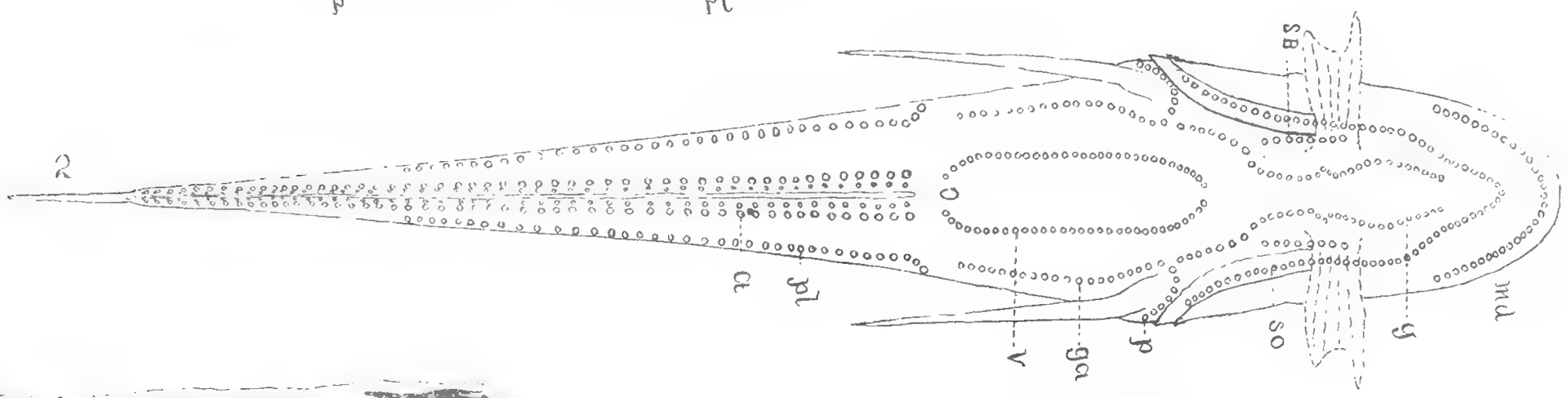
[1] M. Ussow, Ueber den Bau der sogenannten Flecken einiger Knochenfische, Bull. Soc. imp. des. Nat. Moscou, t. LIV, No. 1. p. 79, 1879.

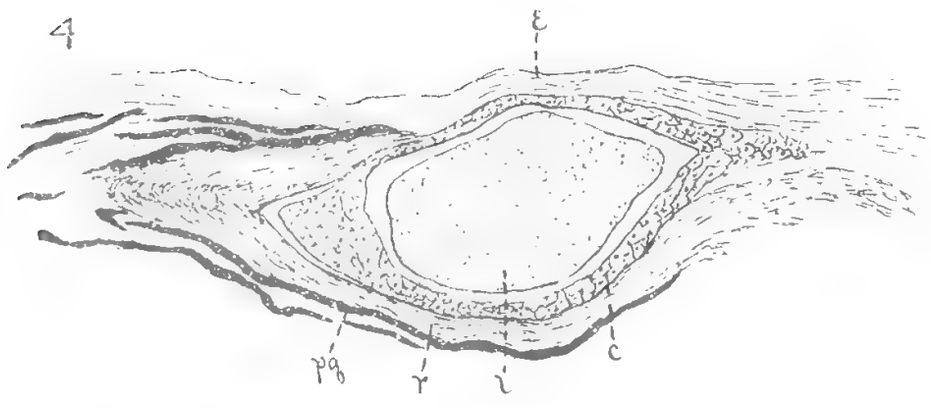
[2] R. von Lendenfeld, Report on the Structure of the Phosphorescent Organs of Fishes, Challenger Reports, Zoology, Vol. XXII, pp. 277–329, plates LXIX–LXXII.

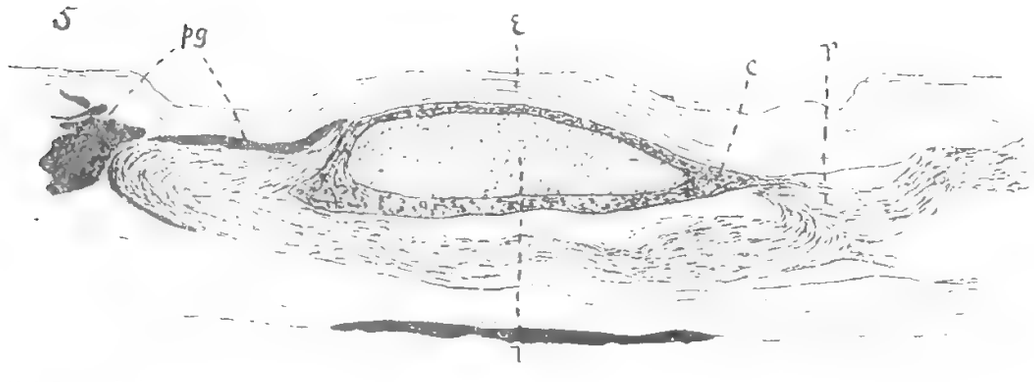
d = dorsal row.
e = fibrous connective tissue.
f = frontal row.
g = gular row.
ga = gastric row.
l in fig. 1 = lateral row; in figs. 3, 4, 5, 6 and 7 = lens.
md = mandibular row.
o = occipital row.
oo = orbitoral row.
op = opercular row.
p = pectoral row.
pg = pigment.
pl = pleural row.
po = postorbital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

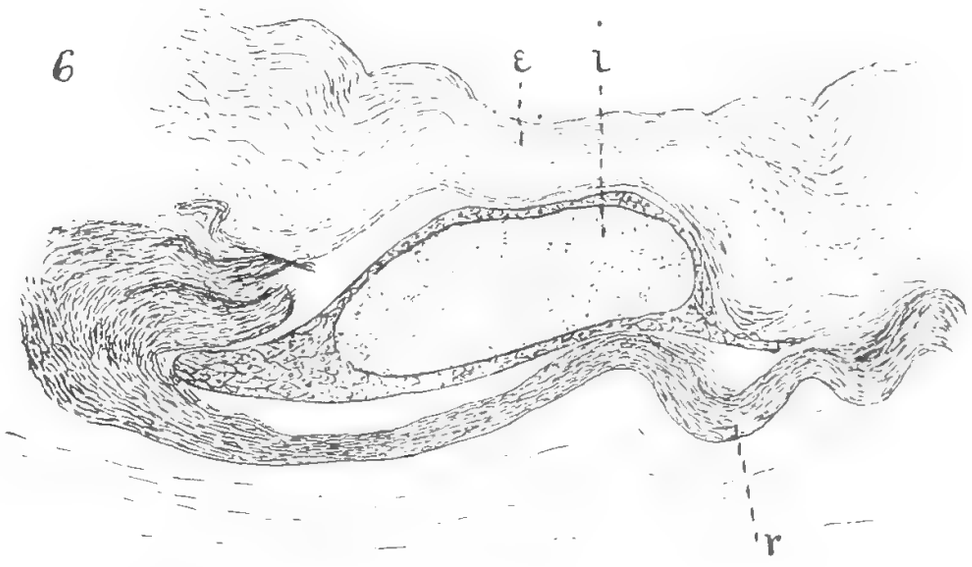
FIG. 1.— Left side of Porichthys, showing arrangement of phosphorescent organs, × ¾.
FIG. 2.— Ventral view of Porichthys, × ¾.
FIG. 3.— Section of frontal organ, × 235.
FIG. 4.— Section of upper opercular organ, × 235.
FIG. 5.— Section of pleural organ, × 235.
FIG. 6.— Section of gastric organ, × 235.
FIG. 7.— Section of outer anal organ, × 235.

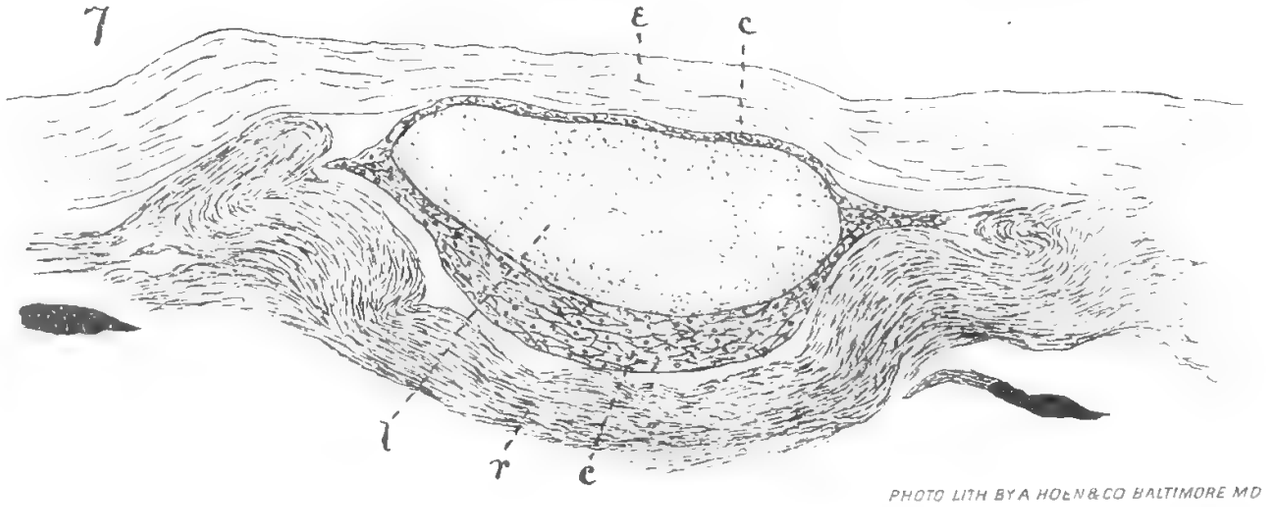












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BULLETIN

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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 Chancellor 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.

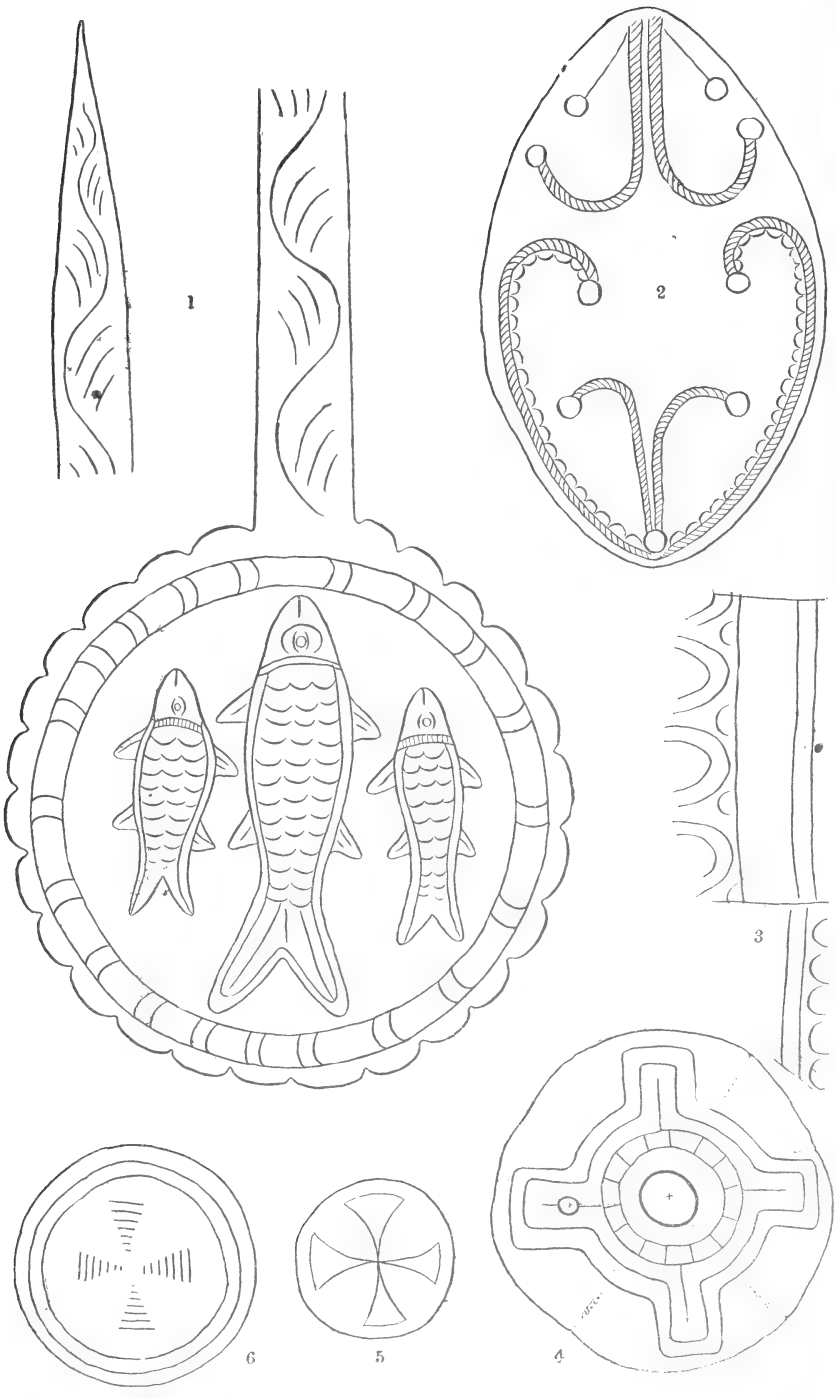
Molybdenite from Gloucester.

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."

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., DANIEL B. HAGAR,
FREDERICK W. PUTNAM, ROBERT S. RANTOUL.

SECRETARY. TREASURER.

HENRY M. BROOKS. GEORGE D. PHIPPEN.

AUDITOR. LIBRARIAN.

RICHARD C. MANNING. CHARLES S. OSGOOD.

COUNCIL.

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

[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.

[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.

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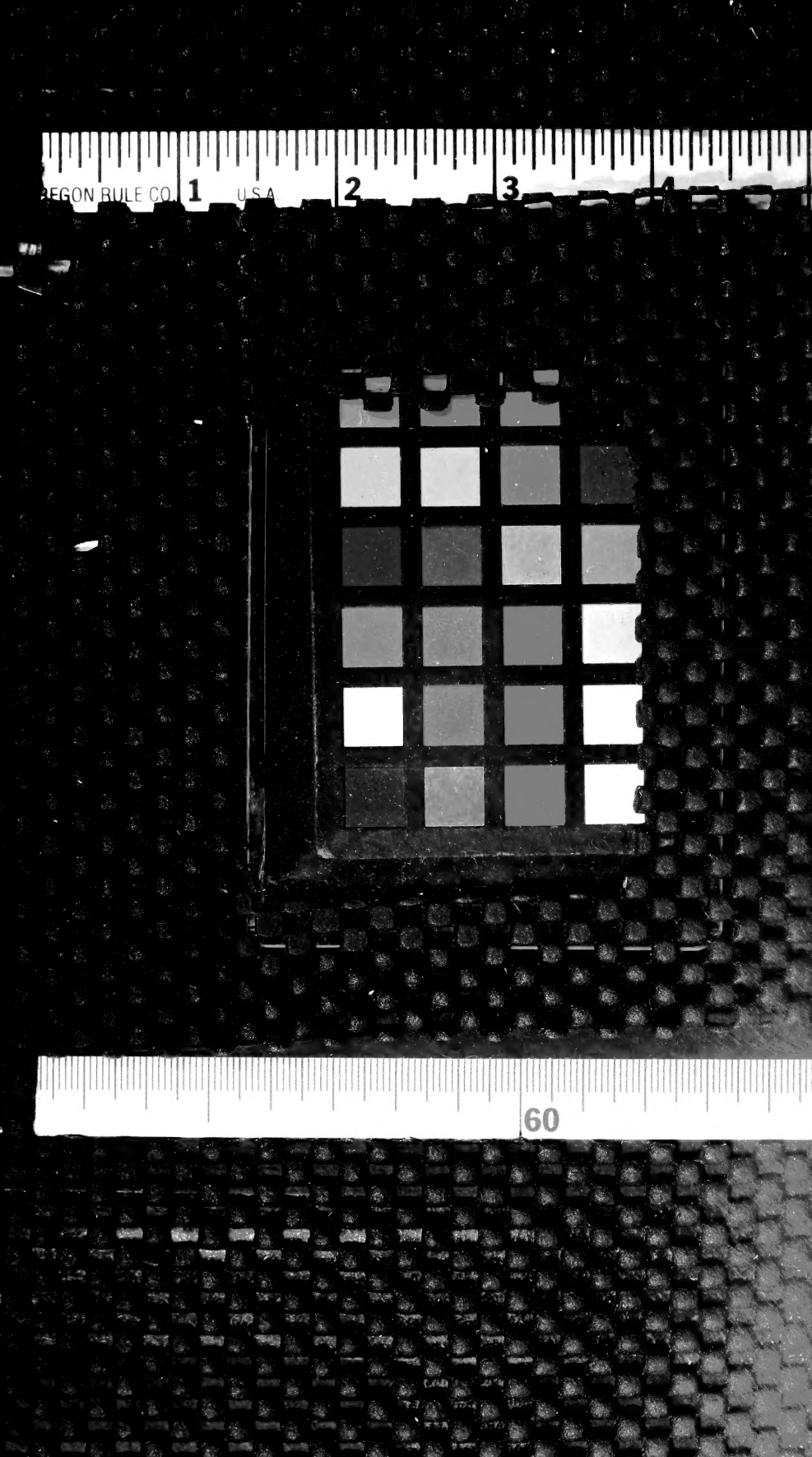
CONTENTS.


EGON RULE CO.
1
U.S.A.
2
3
60