From the American Journal of Science and Arts, Second Series, Vol. IX.

ON THE

SO-CALLED BIOGEN LIQUID.

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THE following pages are devoted to an examination of a letter published in the *American Journal of Science and Arts*,* also of a communication read before the *Boston Natural History Society* in December, 1848.†

The letter consisted of an exposé of three facts and one theory, viz.:

First fact. The formation of the egg in the ovary, as observed in a soft-shelled mollusk (*Ascidia*) and in a worm (*Sigalion*).

Second fact. The germinative vesicle does not always and necessarily disappear before the division of the yolk.

Third fact. There exists in the centre of the germinative spot, a transparent vesicle.

Theory. What embryologists have called albumen in the egg of invertebrated animals, has nothing in common with the albumen of the egg of Vertebrata. This liquid is the *mother liquid* of the yolk, that is to say, of the elements from which a new individual originates; therefore it is called *Biogen.*

These facts which have been added to science were not first made known by Mr. Desor. The theory is really his own. We shall presently see on what it rests.

In the communication read before the Boston Natural History Society, besides a brief account of the letter just mentioned, we find introduced some comparisons between certain pretended phenomena which are said to take place in the earlier age of the egg and the merely conjectural phenomena of the nebular hypothesis.

Without further prefatory remarks, I proceed directly to take up one by one the facts, the theory, and the speculations.

I. The primitive egg has been made the subject of much research by Prof. Agassiz, especially in the department of Mollusca. Ascending even beyond the first existence of the egg, he has shown us the ovary itself in the process of development. This is composed of sacks or pouches varying in form and size, in which the eggs are formed. The sacks are filled with an homogeneous and transparent liquid. Soon this liquid becomes granular, that

* Second Series, vol. vi, No. 21, (May, 1849,) p. 395.
† See Journal of that Society, vol. iii, p. 85.

is, consists of cells, and the cells becoming more and more numerous, give birth to a little opaque sphere, which is the vitellus. The germinative vesicle and the germinative spot have appeared during the formation of the yolk, and sometimes even prior to this period; but at the moment when the phase of division commences, both the spot and the vesicle gênerally disappear, and in the interior of each of the spheres produced by the division, is seen a clear space.

A Résumé of these observations has been published.* Since then, Mr. Desor has observed analogous phases in other animals. He published them, as he had a right to do, but he should have at least declared at the outset, that he was doing nothing more than repeating the observations which another had made before him.

II. When an egg has reached that point of its history which is called its maturity, it is distinguished by the following characters:—a spherical mass, more or less opaque, which is the yolk; in the center of this is found a much smaller sphere, the germinative vesicle, containing another substance, usually transparent; then in the interior of this last, a sphere or spheres still smaller, the germinative spot or spots.

The epoch of the appearance of the germinative spot varies as it would seem within very considerable limits. This is not the place to discuss this question. Let it be observed, however, that they exist in every egg when it is mature, and that they disappear from every egg when it enters upon the period of division.

But among the Nemertes a curious phenomenon is observed. Generally as we have just said, the vesicle and spot disappear before the division of the yolk, or, at least, at the moment when it divides in halves. The secondary spheres resulting from the subdivisions of the vitelline mass, have then, each one in its interior, a clear space. The question has been raised, what part the germinative vesicle plays in the history of the eggs? Is the division the consequence of its disappearance? in other words, is its content necessary to effect the division. The germinative vesicle has been considered as containing the primitive elements of the new being, or an element indispensable to its formation. Now here, among the Nemertes we meet with a case where the yolk is already divided into four parts, while the germinative vesicle still exists. The division of the yolk, then, can take place without the previous bursting of the germinative vesicle.

This fact is set forth and illustrated fully in the Lectures on Comparative Embryology,† and what appears strange to us, is, that Mr. D. now takes for his own, an observation to which he strongly objected when it was first communicated to him. Hav-

* Lectures on Comparative Embryology, by Louis Agassiz. Boston. January, 1849.
† Pages 70, 71.

ing made his observations upon a species different from that in which the fact was originally observed, there was, it seems to me, sufficient merit in pointing it out in another species, without claiming for himself the absolute priority.

III. In 1840, Mr. Martin Barry and Prof. Valentin, simultaneously observed, the one in England in the egg of the Rabbit; the other upon the shores of the Mediterranean, in the egg of a sea Urchin, (*Echinus lividus*,) that the germinative spot is not so simple as had been previously supposed. The observations of Mr. Barry were published during the same year;* those of Prof. Valentin, written in 1840, did not appear till 1842, and at this time he was still unacquainted with those of the English micrographer, for he would not have failed to mention observations so curious and a coincidence so remarkable. Prof. Valentin merely says that a round opaque body is often discerned in the center of the germinative spot.† In 1841, Van Beneden‡ observed a granule in the germinative spot of the *Hydractinia rosea*, and in 1844,§ when reconsidering the same species, he detected an opaque corpuscle within the germinative spot. This fact I have verified in 1848, in the case of the common sea Urchin (or sea egg) of Massachusetts Bay.

More recently Mr. D. says, that he has observed in a worm (*Sigalion*), and a sea anemone (*Actinia*), that the germinative spot contains a clear transparent vesicle. Comparing then this clear vesicle with the opaque nucleus observed by Prof. Valentin, he calls it *Vesicula Valentini*.

We honor the homage rendered to Prof. Valentin :—but Mr. D. has failed to explain how it happens that a transparent vesicle in the worms and sea anemone, is the same thing with the opaque nucleus of the sea Urchins; and moreover he ought not to have overlooked two points of its history, those which belong to Mr. Barry and Van Beneden. By examining more closely, and studying more intimately the contents of the germinative vesicle and of the germinative spot, he might have satisfied himself that the presence of a clear vesicle, or of an opaque nucleus, indicates only two states of one and the same phenomenon, since they are observed alternately in the same species. This is the case with the eggs of Ascidiæ, of Medusæ, of Echini, and probably the eggs of many others.

By merely reading the paper of Mr. Barry, he might have been convinced that this observer had seen much deeper than any of

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* Researches in Embryology: Third Series.

† Anatomie du genre Echinus, p. 105, Pl. viii, fig. 167.

‡ Bulletin de l'Académie de Bruxelles.

§ Recherches sur l'embryogénie des Tubulaires.—Mém. Acad. Brux., vol. xvii, p. 62, Pl. vi, fig. 6.

his predecessors. Mr. Barry has pointed out a cellular content in the germinative vesicle, a thing then new to science; he believes this substance to be produced by changes which take place in the germinative spot. I do not enter into more full details upon the researches of Mr. Barry, for in that case I should be obliged to make some objections of secondary importance, which is not here my object. I had only to point out a fact, to correct an oversight. I now return to my subject.

IV. The researches of Mr. D. upon the development of the eggs of Ascidiæ, have led him to imagine a theory. This theory rests upon a false fact. According to this theory, the primitive state of the egg is a little sphere containing a transparent homogeneous liquid, in the midst of which sphere, may be already seen the outline of the germinative vesicle and spot. By degrees this liquid becomes *turbid*, and the germinative vesicle appears surrounded *by a slight cloud* which increases in extent until it fills the sphere of the egg. Then finally there is a retreat of the matter from the circumference towards the centre of the egg where it is condensed and forms the yolk. A free space remains between this last and the external membrane. This space is filled by a liquid; this liquid is the Biogen.

Having examined during many weeks and continuously each day the eggs of the same Ascidia which was the subject of his observation, I have never witnessed this phenomenon. And yet I examined them in individuals of very different sizes, and in most diverse conditions, taking care always that the egg should remain in its natural state; never, I repeat it, did I see this phenomenon of gradual condensation and of the retreat of the vitellus. Having tried all the good methods of which we can avail ourselves in the use of the microscope, the idea occurred to me to compress strongly a fragment of ovary. What was my surprise, at seeing living copies of the figures published upon this subject. It could even have been easy to make a more complete series of them. The eggs were no longer in their natural state; they were pressed down or crushed, their natural state destroyed, and this was the foundation upon which was built the theory of Biogen liquid, which was to apply to the whole animal kingdom.*

What then is the liquid, and what part does it play in the history of the egg? This liquid is albumen, the albumen which is formed in the ovary, and to judge rightly of the part which it takes in the formation of the egg, some general considerations upon the primitive state of eggs are here necessary.

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* If the Biogen is so general, I would ask why it was not shown in the Sigalion and the Sabella of which Mr. Desor also speaks?

Prof. Agassiz* has already reminded us that the point of departure of the egg is the same as that of the cells of the organic tissues. There is a period when the ovule is only a minute cell. More recent observations confirm these first results. To know the origin of the egg, we must then ascend to the origin of cells.

There are *primordial cells*, and *derived cells*. The experiments of Dr. Ascherson,† have taught us that primordial cells are formed of two substances; of an oily substance and of albumen. Cells perfectly like primordial organic cells can be made artificially by bringing an oily liquid into contact with albumen, although the albumen and the oil or oily matter show a perfect continuity of substance when we examine them separately. But bring them in contact, and cells are formed immediately. Every physiologist can repeat these experiments, and ought to do it.

Primordial cells once formed in the manner above indicated, another phenomenon presents itself. They become nucleated, and these nuclei enlarging, give birth to derived cells.

Thus derived cells are multiplied by the growth of the nuclei, according to the researches of Mr. Martin Barry,‡ of Prof. Agassiz and my own, and whenever the third generation appears, the parent cell bursts and allows its contents to escape; it is in this way that they increase in number.

Now the only difference there is between the cells of the tissues and eggs, is that in these last the parent cell never bursts,§ the primordial cell preserves within itself all the subsequent generations of derived cells; which by their accumulation, form the substance out of which the new individual is produced.

Applying now this knowledge in a more special manner to the development of eggs, we can reply to the question asked above, viz., what part does the albumen play?

At a determinate epoch, for each species, the ovarian sacks are filled with primordial cells. It would be premature to raise the question whether they are formed in the ovary itself, or are brought there already formed. Let us take them, as they exist in the ovary. There under the influence of the organism, they pass through that course of development which we have pointed out as proper to cells destined to become eggs. They contain at first oil. By endosmosis albumen passes through the envelop or membrane, and coming in contact with the oil, cells are formed, the constituent cells of the vitellus (the granules of the yolk).

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* Lectures on Comparative Embryology, 1849, p. 81.

† Ueber den physiologischen Nützen der Fettstoffe und über eine neue auf deren mitwirkung begründete und durch mehrere neue Thatsachen unterstützte Theorie der Zellenbildung.—In Müller's Archiv. fur Anatomie Physiologie, &c. 1840, p. 44. —Comptes Rendus de l'Institut, vol. vii, 1838, p. 837. (*Sur l'usage physiologique des corps gras.*)

‡ Researches in Embryology: Third Series.

§ I mean, at least, as long as the new individual is not ready to escape out of the egg.

When the oil is exhausted, no more cells are formed. The mass of the vitellus then increases, after the ordinary method of multiplication by the growth of nuclei. The albumen itself continues to penetrate through the membrane of the cell, which has now become an egg. It remains under the form of albumen, and surrounds the vitelline globe with a concentric zone more or less thick which increases as the egg grows larger. The intermediate space between the yolk and the external envelop (*chorion*) being increased, one would be tempted to acknowledge a withdrawing of the vitellus from the circumference towards the centre, if it were not known that all parts of the egg enlarge in the same proportions. Besides, a yolk which retreats, which is condensed, ought to occupy a less space, while the contrary is the fact, even as shown by the drawings made by Mr. Desor himself.

The conclusion is doubtless, already anticipated, that the pretended biogen liquid is found to be nothing more than an accumulation of albumen, the albumen formed in the ovary. An embryologist would have known that the yolk of the egg of all animals is composed of albumen and of an oily substance, and that no one has ever supposed the first of these two substances to be formed in the oviduct. When the albumen deposited in the oviduct is spoken of, it is the white which surrounds the yolk of the egg of certain animals that is referred to, and it is altogether gratuitous to attribute to embryologists doubts on this subject. I think Mr. Desor is the only person who has ever confounded the albumen of the vitellus, with the albumen which *surrounds* the essential parts of the eggs common to all animals.

When mature eggs are to be referred to a uniform type, it is necessary to distinguish between the *essential* parts (the vitellus or yolk, the germinative vesicle and the germinative spot), and the *accessory and protective* parts (the external albumen or white, the shell-membrane and the shell itself). The former are identical throughout the animal kingdom, they are never wanting; they are therefore necessary. The latter are not absolutely necessary, and as a proof of this, they are modified according to circumstances, and, in an infinite number of cases, are entirely wanting.

Starting now from the structure of the egg and knowing it to be identical in its constituent elements throughout the whole animal kingdom, the doctrine of its crystallization from a *mother-liquid* refutes itself. The idea that the vitellus is precipitated, or is crystallized, is indeed very strange. Is not this the distinction which we make between the inorganic kingdom and the organic kingdom, that the former is *crystallized*, while the latter is *organized*.

And then as to the physical characters of this biogen liquid, and the method of distinguishing it from albumen, not a word is said. All that has been done is the substitution of a name, the

thing newly named is hidden from the eyes of physiologists. To explain the formation of eggs in the animal kingdom, Mr. D. thus finds himself obliged to procure the intervention of a liquid of which he knows nothing,—a liquid which would make the function of the ovary of secondary importance,—a liquid which would substitute itself for the vital action of the organism, an action which physiology explains,—in fine, an occult liquid, which sound philosophy disowns.

To oppose such a liquid to the vital action of the organism in the procreation of the substance, from which new individuals arise, is to go out of the domain of science. Mr. D. moreover has found that his biogen liquid runs through various modifications. This liquid then has no permanent character, it is under the influence of something beyond it, which produces it in its turn.

Anatomy and physiology are our guides in our embryological researches;—one confirms the other. Remaining within these limits, it was not necessary to go beyond the bounds of sound philosophy, and to fancy a theory which rests upon nothing, which teaches nothing new, which explains nothing, and which stands apart, isolated from physiology.

Thus the theory of biogen, applied to the egg of Ascidia, is not even probable; applied to the animal kingdom it is absurd.

V. § 1. Prepossessed by the false notion that the vitellus is formed by condensation, Mr. D. compares the formation of eggs to that of the celestial bodies, according to the nebular hypothesis.

But in order that a comparison of one phenomenon with some other phenomenon may be established, it is necessary that the one with which the comparison is made, should be perfectly demonstrated,—it must be a law or a principle.

Now the author forgets that the question of the condensation of the heavenly bodies according to the nebular hypothesis, is one of the most controverted questions. The fact is that we know nothing positively respecting the origin of the stars. Has the matter of which they are composed, been diffused throughout space under the form of what has been called nebulæ, and has it been gradually condensed around a nucleus to acquire its sphericity under the power of universal attraction, and to assume then a given movement and a determined direction?

There is no astronomer who can answer this question in the affirmative. From the study of our globe we arrive at the idea that it has had a beginning, and that it was originally in a fluid state. Beyond this, all is conjecture. Reasoning from the earth to the stars, we acknowledge, for all, a beginning of which we are ignorant.

It is then a false generalization to compare the phenomena of ovulation with the theory of the condensation of the sidereal bodies.

But let it be for a moment granted that the stars have been formed by the condensation of matter at first diffused. Where is the analogy between what ought then to take place, and what we witness in the formation of the egg?

The point of departure of organized beings is a sphere—the sphere is the figure of the celestial bodies; this is the whole of the analogy! In that sphere which constitutes the egg, two liquids are brought in contact and having an affinity for each other, they combine and form the vitellus which, from the first, is distributed equally throughout the whole sphere, less dense, it is true, at the beginning; but never showing the least tendency to centripetal motion, the least disposition to be precipitated around the germinative vesicle. There is never any retreat of the vitellus from the periphery towards the centre; there is no gravitation; there is a molecular attraction in the interior of a sphere, there are two liquids which are associated together, and not one liquid creating another out of itself.

Thus then should the theory of the condensation of the heavenly bodies be true, that of the eggs arising from *biogen* would not even be its analogue. Where is the biogen of the stars? No astronomer has had the hardihood to imagine a mother liquid, a gas, or any substance whatever preëxisting in space to create matter, and to disappear after having undergone various modifications.

§ 2. But Mr. D. stops not here. After having found *the great law of attraction at the bottom of the formation of organic bodies*, he comes to the question of movement. "As soon," he says, "as the egg enters upon its organic life, it begins to revolve." There are, indeed, a few invertebrated animals in which the embryo is subjected to a rotatory movement within the envelop of the egg. When one witnesses this for the first time, his thoughts naturally revert to the rotatory movement of the celestial bodies. But on looking deeper into the subject, he soon perceives the difference. I have described the movements which take place in the embryo of a marine Planaria.* I have shown that there is nothing regular about them, no subjection to law. The young animal itself regulates and controls them. There are vibratory ciliæ, that is to say, organs of locomotion, and where these do not exist, vibratory cells. There is not an external force under the dominion of which it is caused to move.

The egg possesses organic life from the moment when it appears under any form whatever, therefore it cannot be said to acquire it when it begins to move. Besides eggs, as eggs, move not; when they move they are no longer eggs; they are *embryos*. For when movement occurs it does not take place till after the division of the yolk; and after that division, the embryo exists.

So that in this view also, the comparison is false.

* Proc. of the Amer. Assoc. for the Adv. of Sciences. Second meeting, held at Cambridge, August, 1849. Cambridge, 1850. 8vo, p. 400.